# **AEROSPACE MEDICINE** AND BIOLOGY

### A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 305)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in December 1987 in

- Scientific and Technical Aerospace Reports (STAR)
- International Aerospace Abstracts (IAA).

### INTRODUCTION

This Supplement to Aerospace Medicine and Biology lists 230 reports, articles and other documents announced during December 1987 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA). The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects of biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

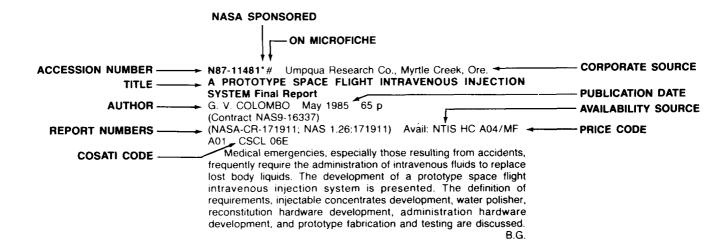
An annual index will be prepared at the end of the calendar year covering all documents listed in the 1987 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

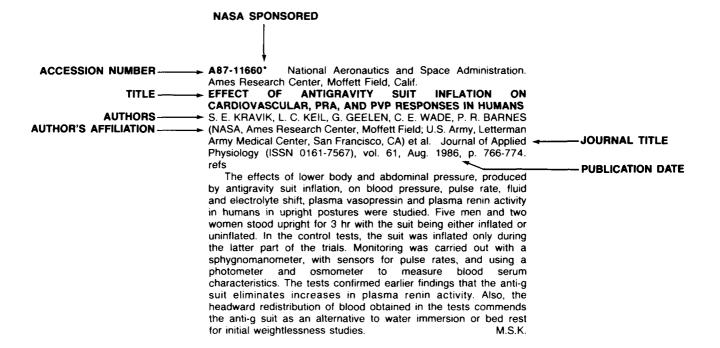
## **TABLE OF CONTENTS**

Category 5	1 Life Sciences (General)	Page 295
Incl	2 Aerospace Medicine udes physiological factors; biological effects of radiation; and effects of ghtlessness on man and animals.	305
Incl	3 Behavioral Sciences udes psychological factors; individual and group behavior; crew training and luation; and psychiatric research.	315
	4 Man/System Technology and Life Support udes human engineering; biotechnology; and space suits and protective hing.	319
	5 Space Biology udes exobiology; planetary biology; and extraterrestrial life.	326
Subject IndexPersonal Author Index		B-1
Foreign Technology Index		
Accession	Number Index	G-1

#### TYPICAL REPORT CITATION AND ABSTRACT



#### TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



# AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 305)

JANUARY 1988

#### 51

#### **LIFE SCIENCES (GENERAL)**

Includes genetics.

#### A87-51106

CHANGES IN BINDING BY THE CORTICOSTERONE RECEPTORS IN DIFFERENT BRAIN STRUCTURES OF RATS UNDER IMMOBILIZATION STRESS [IZMENENIIA SVIAZYVANIIA KORTIKOSTERONA RETSEPTORAMI V RAZLICHNYKHSTRUKTURAKH MOZGA KRYS PRI IMMOBILIZATSIONNOM-STRESSFI

D. A. ZHUKOV (AN SSSR, Institut Fiziologii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, April 1987. p. 465-468. In Russian. refs

#### A87-51107

THE HORMONAL FUNCTION OF THE INSULIN APPARATUS AND THE INSULIN-BINDING CAPACITY OF ERYTHROCYTES IN ADAPTATION OF RATS TO HIGH ALTITUDE [GORMONAL'NAIA FUNKTSIIA INSULIARNOGO APPARATA I INSULINSVIAZUIUSHCHAIA SPOSOBNOST' ERITROTSITOV PRI ADAPTATSII KRYS K VYSOKOGOR'IU]

N. E. TIKHONOVA, E. M. KUCHUK, and V. G. SHALIAPINA (AN SSSR, Institut Fiziologii, Leningrad, USSR; Kirgizskii Gosudarstvennyi Meditsinkii Institut, Fru Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, April 1987, p. 469-474. In Russian. refs

Changes in the blood concentrations of glucose, glucagon, and insulin and in the binding capacity of insulin receptors on erythrocytes were monitored in rats during their adaptation to an altitude of 3200 m. During the first 14 days, the levels of insulin and glucagon decreased steadily, while the levels of glucose remained close to control (after a short-term decrease observed on the day 3). In the same period, the insulin-binding capacity of erythrocytes increased, with particularly sharp rises observed on days 3 and 14. These reactions are considered to be compensatory, effecting the maintenance of the glycolysis level in erythrocytes and thus the correction of tissue hypoxia.

#### A87-51108

THE EFFECT OF ADAPTATION TO COLD AND OF SHORT-TERM EXPOSURE TO COLD ON THE RESISTANCE OF ANIMALS TO HYPOXIC HYPOXIA [VLIIANIE KHOLODOVOI ADAPTATSII I KRATKOVREMENNOGO DEISTVIIA KHOLODA NA USTOICHIVOST' ZHIVOTNYKH K GIPOKSICHESKOI GIPOKSII]

I. A. GOROSHINSKAIA and G. M. RUDIK (Rostovskii Gosudarstvennyi Universitet, Rostov-on-Don, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, April 1987, p. 532-536. In Russian. refs

The effect of high-altitude (9000 and 12,000 m) hypoxia on rats adapted to cold (45 days at 2 C) and on unadapted rats subjected to cold-related stress (3 days at 2 C) was studied using the life duration, the frequency of seizures, and the activity and substrate specificity of brain mitochondrial monoamine oxidase to monitor the sensitivity to hypoxia. The animals adapted to cold

were more resistant to hypoxia than controls; they exhibited an increase of life duration at 12,000 m, a decrease in seizure frequency, and showed no changes, typical for hypoxia, in the catalytic properties of brain mitochondrial monoamine oxidase. On the other hand, nonadapted cold-stressed rats exhibited reduced resistance to hypoxia, relative to controls.

#### A87-51109

THE DEPENDENCE OF THE VESTIBULAR REACTIONS OF CAT CORTICAL NEURONS ON THE DURATION AND DIRECTION OF SINUSOIDAL ROTATION [ZAVISIMOST' VESTIBULIARNYKH REAKTSII NEIRONOV KORY KOSHKI OT DLITEL'NOSTI I NAPRAVLENIIA SINUSOIDAL'NOGO VRASHCHENIIA]

V. S. DEM'IANENKO (AN SSSR, Institut Fiziologii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, April 1987, p. 541-544. In Russian. refs

The effects of reversible and unidirectional sinusoidal rotations (2 h at 0.1-0.2 Hz) with continuously changing angular speed on the impulse activity of vestibular neurons were studied in cats fitted with electrodes that were implanted in the area of the suprasylvian sulcus. To determine the possibility of adaptation, the effect of prolonged rotations was also investigated. The poststimulus histograms revealed the presence of the directional dependence of vestibular neuronal reactions caused by angular acceleration.

#### A87-51110

REACTION OF THERMOREGULATORY NEURONS TO DIFFERENT TYPES OF SENSORY STIMULATION [REAKTSIIA NEIRONOV TSENTRA TERMOREGULIATSII NA VOZDEISTVIIA RAZLICHNOI SENSORNOI MODAL'NOSTI]

L. P. DYMNIKOVA (AN SSR, Institut Fiziologii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, April 1987, p. 547-549. In Russian. refs

The responses of hypothalamic neurons to thermal, mechanical, acoustical, and light stimuli were studied in anesthetized rabbits fitted with electrodes in the medial preoptic region and the ventromedial and dorsomedial nuclei of the hypothalamus. The neuronal impulse activity was registered continually; an increase in the impulse frequency of a given neuron signified a reaction. It was found that, among hypothalamic neurons reacting to thermal stimuli, some were also responsive to nonspecific stimuli, such as a mechanical irritation of skin, light flashes, and sound signals. These polysensory neurons are believed to play a part in the behavioral reactions of an animal to cold.

#### A87-51125

FORMATION OF SINGLE-STRAND BREAKS IN DNA UNDER THE EFFECT OF HIGH-INTENSITY UV RADIATION [OBRAZOVANIE ODNONITEVYKH RAZRYVOV V DNK PRI DEISTVII UF IZLUCHENIIA VYSOKOI INTENSIVNOSTI]

T. G. BURCHULADZE (Tbilisskii Gosudarstvennyi Universitet, Tbilisi, Georgian SSR) Akademiia Nauk Gruzinskoi SSR, Soobshcheniia (ISSN 0132-1447), vol. 126, May 1987, p. 393-396. In Russian. refs

High-intensity UV-laser radiation at 266 nm was found to produce single-strand breaks in DNA due to two-photon photochemical reactions. It is noted that radiation-induced damage of this type makes an important contribution to the laser-induced inactivation of cells and provides for an increase in their sensitivity

as compared with the effect of low-intensity UV radiation from ordinary sources.

A87-51151\* Maryland Univ., Baltimore.

A POSSIBLE ROLE FOR ENDOGENOUS GLUCOCORTICOIDS IN ORCHIECTOMY-INDUCED ATROPHY OF THE RAT LEVATOR ANI MUSCLE - STUDIES WITH RU 38486, A POTENT AND SELECTIVE ANTIGLUCOCORTICOID

MASAAKI KONAGAYA and STEPHEN R. MAX (Maryland, Journal of Steroid Biochemistry (ISSN University, Baltimore) 0022-4731), vol. 25, no. 3, 1986, p. 305-308. Previously announced in STAR as N86-30343. refs (Contract NAG2-100)

RU38486, a potent and selective antiglucocorticoid, was employed to study a possible role for endogenous glucocorticoids in atrophy of the levator ani muscle secondary to castration of male rats. RU38486 was shown to block (3H) triamcinolone acetonide binding to cytosol from levator ani muscle. Daily oral administration of RU38486 to castrated rats partially prevented atrophy of the levator ani muscle, as well as a decrease in RNA concentration. In a control group receiving RU38486 alone, the levator ani underwent significant 20 percent hypertrophy. Administration of exogenous dexamethasone also caused pronounced atrophy of the levator ani muscle. This atrophy was prevented, to a significant degree, by simultaneous oral administration of Ru38486. It is concluded that endogenous glucocorticoids, the actions of which are blocked by RU38486. may be involved in regulation of the mass of the levator ani muscle in intact rats.

#### A87-51251 BACTERIAL ACTIVITY IN THE WARMER, SULPHATE-BEARING, ARCHAEAN OCEANS

HIROSHI OHMOTO and ROBERT P. FELDER (Pennsylvania State University, University Park) Nature (ISSN 0028-0836), vol. 328, July 16, 1987, p. 244-246. NSF-supported research. refs

In recent marine sediments, bacterial reduction of seawater sulfate is responsible for the formation of diagenetic sulfides, which are typically strongly depleted in S-34 relative to source sulfate and highly variable in delta S-34 values. In contrast, the delta S-34 values of Archaean sedimentary sulfides are generally less variable and nearly identical to those of sulfates in the same sedimentary units. Previous investigators have suggested that either sulfate-reducing bacteria had yet to develop in Archaean time and/or Archaean oceans contained much less sulfate and hence much less free oxygen than the present atmosphere. It is argued here that the sulfur isotope data on Archaean sediments from 2600 to 3500 Myr old can be better explained if sulfate-reducing bacteria were already active in oceans with temperatures of 30-50 C and containing appreciable amounts of sulfate, with delta S-34 values of about +3 per mil. C.D.

#### A87-51465

THE **O-PHOTOINTERMEDIATE** BACTERIORHODOPSIN PHOTOCYCLE IN NATIVE AND ENZYME TREATED PURPLE MEMBRANE FRAGMENTS AS A **FUNCTION OF PH** 

L. KESZTHELYI (Magyar Tudomanyos Akademiia, Biofizikai Intezet, Szeged, Hungary) and S. G. TANEVA (B'Igarska Akademiia na Naukite, Tsentralna Laboratoriia po Biofizika, Sofia, Bulgaria) Bolgarskaia Akademiia Nauk, Doklady (ISSN 0366-8681), vol. 40, no. 5, 1987, p. 127-130. refs

#### A87-51673

COMPARATIVE CHARACTERIZATION OF THE SLEEP-WAKE-FULNESS CYCLE IN HIBERNATING AND NONHIBERNATING MAMMALS [SRAVNITEL'NAIA KHARAKTERISTIKA TSIKLA BODRSTVOVANIE-SON U ZIMOSPIASHCHIKH I NEZIMOS-PIASHCHIKH MLEKOPITAIUSHCHIKHI

I. G. KARMANOVA, M. M. BOGOSLOVSKII, and L. V. ANDREEVA (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, Fiziologicheskii Zhurnal SSSR, (ISSN 0015-329X), vol. 73, May 1987, p. 595-601. In Russian. refs

#### A87-52215

HEAD-DOWN TILT AND RESTRAINT ON RENAL FUNCTION AND GLOMERULAR DYNAMICS IN THE RAT

B. J. TUCKER, C. A. MUNDY, M. G. ZIEGLER, C. BAYLIS, and R. C. BLANTZ (California, University, La Jolla; USVA, Medical Center, San Diego, CA) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 505-513. USVA-supported research, refs

(Contract NIH-AM-28602; NIH-HL-31933)

The effect of 25-deg head-down tilt (HDT) on the extracellular fluid volume and the renal function of rat were studied using rats fitted with chronically indwelling cannulas in the femoral vein and artery and in the bladder. After 24 h of HDT, increases were observed in the values of the glomerular filtration rate (GFR). renal plasma flow (RPF), urine flow rate, and Na(+) and K(+)excretions, as well as in extracellular volume (whereas the nontilted suspended controls exhibited a decrease in extracellular volume). After 7 days of HDT, the GFR decreased (by 7 percent), while the RPF and the extracellular volume returned to the levels at day zero. By this time, the control rats exhibited increased levels of GFR and RPF.

#### A87-52216 **STRUCTURAL** AND **FUNCTIONAL RESPONSES** TO PROLONGED HINDLIMB SUSPENSION IN RAT MUSCLE

D. DESPLANCHES, M. H. MAYET, B. SEMPORE, and R. FLANDROIS (Lyon I, Universite, France) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 558-563.

Changes effected in oxygen uptake, muscle capillarization, oxidative enzyme activities, and resting-muscle energy charge in the soleus (SOL) and extensor digitorum longus (EDL) muscles of rats after prolonged tail suspension were investigated. Tail suspension for 5 wks resulted in significant decreases in O2 uptake (19 percent) and muscle mass (63 in the SOI and 23 percent in EDL). No changes in fiber area, capillarization, and enzymatic activities occurred in EDL; in SOL, a decrease in the number of capillaries per fiber and in the activities of citrate synthase and 3-hydroxyacyl-CoA dehydrogenase were recorded. Tail suspension for 5 wks also caused transitions within the five histochemically identifiable muscle fiber types (I, IIa, and IIb and intermediate fiber types int I and int II): a reduction of type I distribution was accompanied by an increase of int I in SOL and int II in EDL. I.S.

#### A87-52217 SPECIES VARIATION IN LUNG ANTIOXIDANT ENZYME **ACTIVITIES**

CHARLES L. BRYAN and STEPHEN G. JENKINSON (Texas, University; USAF, Medical Center; Southwest Foundation for Biomedical Research; Audie Murphy Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 597-602. USVA-supported research. refs

(Contract NIH-HL-30556)

Lung antioxidant enzyme systems of rats, hamsters, baboons, and humans were compared by measuring the activities of glutathione peroxidase (GSH-Px), superoxide dismutase (SOD), catalase (CAT), and glutathione S-transferase (GSH S-trans) in the homogenates and/or extracts of the lung tissue of these animal groups. The results indicate that, among the animals studied, hamster is the best model for mimicking human lung with respect

to the antioxidant enzyme activities. On the other hand, rat lung antioxidant enxyme activities were markedly different from any of the other species examined.

I.S.

#### A87-52220

## TIME-DEPENDENT EFFECT OF HYPOXIA ON CAROTID BODY CHEMOSENSORY FUNCTION

P. BARNARD, S. ANDRONIKOU, M. POKORSKI, N. SMATRESK, A. MOKASHI (Pennsylvania, University, Philadelphia) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 685-691. refs

(Contract NiH-HL-19737-10; NiH-HL-07027)

The time-dependent effects of acute and chronic hypoxia on the function of the carotid chemoreceptors were investigated in cats after short (2-3 h) or prolonged (28 days) exposures to hypoxia. The chemoreceptor activity was measured as described by Lahiri et al. (1983). It was found that the response of the carotic chemoreceptor afferents to a given level of acute hypoxia (PaO2 = 30-40 Torr) did not significantly change within 2-3 h. In contrast, chronic hypoxia significantly increased the hypoxic responsiveness. It is suggested that this enhanced chemoreceptor activity may contribute to the ventilatory acclimatization in chronic hypoxia.

1.5

#### A87-52222

## O2 DELIVERY TO CONTRACTING MUSCLE DURING HYPOXIC OR CO HYPOXIA

C. E. KING, S. L. DODD, and S. M. CAIN (Alabama, University, Birmingham) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 726-732. Research supported by the Canadian Heart Foundation. refs (Contract NIH-HL-14693; NIH-HL-26927)

The effects of hypoxic hypoxia (HH) or CO hypoxia (COH) on a contracting muscle were compared using canine gastrocnemius-plantaris preparations in which muscle O2 uptake, blood flow, oxygen extraction, and tension were measured at rest and at 1 twitch/s isometric contractions in normoxia and in HH and COH hypoxias (9 percent O2 in N2 or 1.0 percent CO in air, respectively). At rest, no difference was observed between HH and COH. During contractions during COH, the O2 uptake decreased from the normoxic level; the O2 uptake did not change in the HH group. Blood flow increased in both groups during hypoxia, but more so in the COH group. O2 extraction by the muscle increased with hypoxia in the HH group, but actually fell in the COH group. Thus, the O2 uptake limitation during COH contractions is associated with a lesser O2 extraction, suggesting that the leftward shift in the oxyhemoglobin dissociation curve during COH may have impeded tissue O2 extraction.

# A87-52253\* Bionetics Corp., Cocoa Beach, Fla. POROUS MEMBRANE UTILIZATION IN PLANT NUTRIENT DELIVERY

T. W. DRESCHEL, C. R. HINKLE (Bionetics Corp., Cocoa Beach, FL), R. P. PRINCE, and W. M. KNOTT, III (NASA, Kennedy Space Center, Cocoa Beach, FL) American Society of Agricultural Engineers, Summer Meeting, Baltimore, MD, June 28-July 1, 1987. 9 p. refs

(ASAE PAPER 87-0425)

A spacecraft hydroponic plant growth unit of tubular configuration, employing a microporous membrane as a capilary interface between plant roots and a nutrient solution, is presented. All three of the experimental trials undertaken successfully grew wheat from seed to harvest. Attention is given to the mass/seed, number of seeds/head, ratio of seed dry mass to total plant dry mass, production of tillers, and mass of seed/plant. Dry matter production is found to be reduced with increasing suction pressure; this is true for both average seed and average total dry matter/plant. This may be due to a reduction in water and nutrient availability through the microporous membrane.

#### A87-52976

LIFE SCIENCES AND SPACE RESEARCH XXII(2); PROCEEDINGS OF THE TOPICAL MEETING AND WORKSHOP 4 OF THE 26TH COSPAR PLENARY MEETING, TOULOUSE, FRANCE, JUNE 30-JULY 11, 1986

G. M. MALACINSKI, ED. (Indiana University, Bloomington), H. OSER, ED. (ESA, Paris, France), G. HORNECK, ED. (DFVLR, Cologne, West Germany), K. DOSE, ED. (Mainz, Universitaet, West Germany), and H. HINGHOFER-SZALKAY, ED. (Graz, Universitaet, Austria) Meetings and Workshop sponsored by COSPAR. Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, 339 p. For individual items see A87-52977 to A87-53016.

The conference presents papers on gravitational biology, the results of space flight experiments, exobiology experiments in earth orbit, the limits of life, and the gravity response in man. Topics include the classification of gravity effects on 'free' cells, the effects of gravity perturbation on developing animal systems, the possible effects of organelle charge and density on cell metabolism, and investigations onboard the biosatellite Cosmos-1667. Consideration is also given to the application of the Space Station gas-grain simulation facility to exobiology, observational astrochemistry, molecular aspects of adaptation to extreme cold environments, the Antarctic cold desert and the search for traces of life on Mars, and system interrelations of gravity responses in the human organism and the use of modeling.

## A87-52977 PHYSICAL PARAMETERS AFFECTING LIVING CELLS IN

DIETER LANGBEIN (Battelle-Institut, Frankfurt am Main, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 5-14. refs

Issues associated with biology in space are addressed and it is noted that the absence of gravity means constancy of the hydrostatic pressure and the absence of free convection and sedimentation. Examples are given which illustrate how significantly pressure and convection affect species arrangement, species transport, electric fields, and currents. The paper presents an order of magnitude analysis of the residual accelerations tolerable during materials sciences.

K.K.

#### A87-52978

#### CLASSIFICATION OF GRAVITY EFFECTS ON 'FREE' CELLS

W. BRIEGLEB and I. BLOCK (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 15-19. refs

A scheme is presented of the smallest functional units of organisms and their interaction with gravity. It is noted that a special approach is needed when free living cells with densities higher than that of the liquid medium, or even cells living on a free surface, are observed. In these two cases, allowance must be made for indirect effects as well; this is demonstrated using the slime mold Physarum polycephalum.

K.K.

# A87-52979\* Indiana Univ., Bloomington. AMPHIBIAN EGG CYTOPLASM RESPONSE TO ALTERED G-FORCES AND GRAVITY ORIENTATION

A. W. NEFF, R. C. SMITH, and G. M. MALACINSKI (Indiana University, Bloomington) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 21-28. refs

(Contract NAG2-323)

Elucidation of dorsal/ventral polarity and primary embryonic axis development in amphibian embryos requires an understanding of cytoplasmic rearrangements in fertile eggs at the biophysical, physiological, and biochemical levels. Evidence is presented that

#### 51 LIFE SCIENCES (GENERAL)

amphibian egg cytoplasmic components are compartmentalized. The effects of altered orientation to the gravitational vector (i.e., egg inversion) and alterations in gravity force ranging from hypergravity (centrifugation) to simulated microgravity (i.e., horizontal clinostat rotation) on cytoplasmic compartment rearrangements are reviewed. The behavior of yolk compartments as well as a newly defined (with monoclonal antibody) nonyolk cytoplasmic compartment, in inverted eggs and in eggs rotated on horizontal clinostats at their buoyant density, is discussed.

Author

# A87-52980\* Indiana Univ., Bloomington. EFFECTS OF GRAVITY PERTURBATION ON DEVELOPING ANIMAL SYSTEMS

G. M. MALACINSKI and A. W. NEFF (Indiana University, Bloomington) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 29-36. refs (Contract NAG2-323)

The use of developing animal systems to analyze the effects of microgravity on animals is discussed. Some of the key features of developing systems, especially embryos, are reviewed and relevant space data are summarized. Issues to be addressed in the design of future space experiments are discussed. It is noted that an embryo which exhibits ground based gravity effects should be selected for use as a model system and individual variation in gravity response among batches of embryos should be taken into account.

K.K.

#### A87-52981

#### GEOTROPIC SENSITIVITY EXHIBITED BY SINGLE HORNETS -THE INFLUENCE OF CASTE, AGE, LIGHT AND TEMPERATURE

JACOB S. ISHAY, EYAL ROSENZWEIG, and IRIT ABIR (Tel Aviv University, Israel) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 37-40. refs

Hornet workers, queens, and males, aged 0-24 hours (i.e. juveniles) and 24 hours and more (i.e. adults) were tested for their responses to changes in the direction of the gravitational force while placed on a flat surface gradually tilted between 0.5 and 180 deg. The tests were run on nonblind and blind hornets, at temperatures ranging between 18 C and 35 C, in daylight as well as in the dark. Up to 18 hours of age, negative phototaxis prevailed among the hornets, which displayed a clear preference for remaining in the dark regardless of the geotropic position. Between 18-24 hours of age, there was gradual appearance of a sensitivity to change in the geotropic position. Above 24 hr of age, the hornets became sensitive to changes in their declinations, with workers becoming sensitive at a 3-5 deg declination, queens at 4-5 deg, and males at a declination of 8-19 deg from the horizontal. Author

#### A87-52982

## THE ORIGIN AND EVOLUTION AND COMPARATIVE PHYSIOLOGY OF GRAVITY SENSING ORGANS

ALLAN H. BROWN (Pennsylvania, University, Philadelphia) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 41-45. refs

The origin of bioaccelerometers is discussed and the question of whether animals or plants were the first to invent bioaccelerometers is addressed. It is noted that, although the earth's gravity has been essentially constant, the perfection of bioaccelerometers has been driven by evolutionary pressures. The comparative physiology of bioaccelerates is discussed as well as a navigational role for g sensing, biological memory, the reciprocity rule, and the use of variable gravity for producing unique test conditions.

# A87-52983\* Michigan State Univ., East Lansing. POSSIBLE EFFECTS OF ORGANELLE CHARGE AND DENSITY ON CELL METABOLISM

ROBERT S. BANDURSKI, AGA SCHULZE, and W. DOMAGALSKI (Michigan State University, East Lansing) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 47-54. refs

(Contract NAGW-97; NAG2-362; NSF DMB-85-04231)

A system of perception and transduction involving the gravity-induced asymmetric distribution of a plant growth hormone is studied. A theory is constructed which assumes that the perception of the gravitational stimulus involved a perturbation of the plant's bioelectric field and that the transduction of the stimulus involved voltage-gating of hormone movement from the plant's vascular tissue into the hormone responsive growing tissue. Particular attention is focused on the barriers to indole-3-acetic acid (IAA) transport from the seed to the mesocotyl cortex, the protoinhibition of IAA movement from the endosperm to the shoot, the effects of the gravitational stimulus on the movement of IAA from the kernel to the shoot, electrochemical gating as a target for the gravity stimulus, and the gravity sensing mechanism.

K.K

# A87-52984 POLARITY OF ROOT STATOCYTES - RELEVANCE FOR GRAVIPERCEPTION

W. HENSEL (Bonn, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 55-59. refs

During outgrowth of the radicle of cress (Lepidium sativum L.) the statocytes of the root cap develop a structural polarity with the nucleus at the proximal cell pole and a complex of endoplasmic reticulum (ER) at the distal cell pole. Amyloplasts sediment upon this complex of ER. During all stages of development the cytoskeleton (microtubules, microfilaments) is involved in positioning of the ER. The structural polarity of the statocytes develops independently of gravity, as indicated by corresponding results from fast and slow rotating clinostats and roots grown under microgravity in orbit. Disturbance of the structural polarity is possible by application of drugs, influencing microtubules and microfilaments. If, by rotation of roots on slow rotating clinostats or centrifugation, the structural polarity of the statocytes is changed, the ability of the roots to perceive gravity is affected also.

Author

# A87-52985\* Ohio State Univ., Columbus. ROLE OF CALCIUM IN GRAVITY PERCEPTION OF PLANT ROOTS

MICHAEL L. EVANS (Ohio State University, Columbus) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 61-65. refs

(Contract NAGW-297; NSF PCM-83-05775)

Calcium ions may play a key role in linking graviperception by the root cap to the asymmetric growth which occurs in the elongation zone of gravistimulated roots. Application of calcium-chelating agents to the root cap inhibits gravitropic curvature without affecting growth. Asymmetric application of calcium to one side of the root cap induces curvature toward the calcium source, and gravistimulation induces polar movement of applied (Ca-45)(2+) across the root cap toward the lower side. The action of calcium may be linked to auxin movement in roots since: (1) auxin transport inhibitors interfere both with gravitropic curvature and graviinduced polar calcium movement and (2) asymmetric application of calcium enhances auxin movement across the elongation zone of gravistimulated roots. Indirect evidence indicates that the calcium-modulated regulator protein,

calmodulin, may be involved in either the transport or action of calcium in the gravitropic response mechanism of roots. Author

#### A87-52986\* Texas Univ., Austin.

# DISTRIBUTION OF CALMODULIN IN CORN SEEDLINGS - IMMUNOCYTOCHEMICAL LOCALIZATION IN COLEOPTILES AND ROOT APICES

M. DAUWALDER and S. J. ROUX (Texas, University, Austin) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 67-70. refs (Contract NSG-7480)

Immunofluorescence techniques have been used to study the distribution of calmodulin in several tissues in etiolated corn (Zea mays, var. Bear Hybrid) seedlings. Uniform staining was seen in the background cytoplasm of most cell types. Cell walls and vacuoles were not stained. In coleoptile mesophyll cells the nucleoplasm of most nuclei was stained as was the stroma of most amyloplasts. The lumen border of mature tracheary elements in coleoptiles also stained. In the rootcap the most intensely stained regions were the cytoplasms of columella cells and of the outermost cells enmeshed in the layer of secreted slime. Nuclei in the rootcap cells did not stain distinctly, but those in all cell types of the root meristem did. Also in the root meristem, the cytoplasm of metaxylem elements stained brightly. These results are compared and contrasted with previous data on the localization of calmodulin in pea root apices and epicotyls and discussed in relation to current hypotheses on mechanisms of gravitropism.

# A87-52987 INTERACTION OF GROWTH-DETERMINING SYSTEMS WITH GRAVITY

A. MERKYS, R. LAURINAVICIUS, D. BENDORAITYTE, D. SVEGZDIENE, and O. RUPAINIENE (AN LSSR, Institut Botaniki, Vilnius, Lithuanian SSR) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 71-80. refs

Results of experiments performed with lettuce shoots onboard the Salyut-7 orbital station, the Kosmos-1667 biosatellite, and under terrestrial conditions at 180-deg plant inversion are presented. By means of the centrifuge Biogravistat-1 M, the threshold value of the gravitational sensitivity of the lettuce shoots was determined on Salyut-7 to be equal to 0.0029 g for hypocotyls and 0.00015 g for roots. Kosmos-1667 results revealed that, under microgravity, the proliferation of the meristem cells and the growth of roots did not differ from the control and that the transverse growth of hypocotyls was significantly increased due to the enhancement of cortical parenchyma cell growth.

#### A87-52988

## BIOSCIENCE EXPERIMENTS IN THE GERMAN SPACELAB MISSION D-1 - INTRODUCTION AND SUMMARY

G. HORNECK (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany), G. GREGER (BMFT, Bonn, West Germany), and P. R. SAHM (Aachen, Rheinisch-Westfaelische Technische Hochschule, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 85-99. refs

Bioscience experiments performed during the German Spacelab mission D-1 (October 30-November 6, 1985) are reviewed. The role of gravity in the vital functions of biological systems was studied with emphasis placed on intra- and intercellular interactions, developmental processes, and regulation and adaptation in highly organized systems (including humans). Moreover, consideration was given to the effect of cosmic radiation. It is noted that The Bioscience Experiment Package and ESA's Vestibular Sled and Biorack were used for these experiments. K.K.

#### A87-52989

#### INVESTIGATIONS ONBOARD THE BIOSATELLITE COSMOS-1667

O. G. GAZENKO and E. A. IL'IN (Institut Mediko-Biologicheskikh Problem, USSR) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 101-106.

The program of the 7-day flight of the biosatellite Cosmos-1667 launched in July 1985 included experiments on two rhesus monkeys, ten Wistar SPF rats, ten newts, Drosophila flies, maize seedlings, lettuce sprouts, and unicellular organisms - Tetrahymena. The primate study demonstrated that transition to orbital flight was accompanied by a greater excitability of the vestibular apparatus and an increased linear blood flow velocity in the common carotid artery. The rat studies showed that atrophy of antigravity muscles and osteoporosis of limb bones developed even during short-term exposure to microgravity. The experiments on other living systems revealed no microgravity effects on the cell division rate, proliferative activity of cells of regenerating tissues and organs, energy metabolism of developing insects, structure or chemical composition of higher plant seedlings.

#### A87-52991

## EMBRYOGENESIS AND ORGANOGENESIS OF CARAUSIUS MOROSUS UNDER SPACEFLIGHT CONDITIONS

H. BUECKER, R. FACIUS, G. HORNECK, G. REITZ (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany), and E. H. GRAUL (Marburg, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 115-124. BMFT-supported research. refs

ESA's Biorack, flown on the German Spacelab D-1 mission, was used to study the influence of HZE particles of cosmic radiation and/or microgravity on the eggs of the stick insect Carausius morosus. Hatching rates, growth kinetics, and anomaly frequencies were determined. The early developmental stages were highly sensitive to single hits of cosmic ray particles as well as to microgravity. Hits by single HZE particles caused body anomalies and retarded growth after hatching.

#### A87-52993

# GENETIC AND PHYSIOLOGICAL DAMAGE INDUCED BY COSMIC RADIATION ON DRY PLANT SEEDS DURING SPACE FLIGHT

A. R. KRANZ (Frankfurt, Universitaet, Frankfurt am Main, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 135-138. refs

Biostack experiments were performed to assess the role of cosmic HZE radiation in disturbing plants through their ontogenesis and mutation processes. Dry Arabidopsis seeds flown for 10 days on STS-9 experienced severe radiation damage in space. The lethality of seeds, the number of embryonic lethals, and the rate of form and leaf color mutants was highest for seeds exposed on the pallet inside the module.

#### A87-52995

## CONFIRMATION OF GRAVISENSITIVITY IN THE SLIME MOLD PHYSARUM POLYCEPHALUM UNDER NEAR WEIGHTLESSNESS

I. BLOCK, W. BRIEGLEB, V. SOBICK (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany), and WOHLFARTH-BOTTERMANN (Bonn. Universitaet. West (COSPAR, Plenary Meeting, 26th, Topical Meeting Germany) and Workshop 4 on Life Sciences and Space Research XXII/2/. Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 143-150. refs

Physarum polycephalum, a unicellular organism with no special gravity receptors, was studied with emphasis placed on its ability to react to gravity. Ground-based g-simulation experiments on the fast-rotating clinostat were conducted with the plasmodial strands of this slime mold. Among the parameters observed were the periodicity of the contractions and the dilations of the strand's ectoplasm. During 0 g-simulation, these parameters showed significant changes indicating that the slime mold is gravity-sensitive. It is noted that, under real near weightlessness (in the D1-Space Shuttle mission) the slime mold showed a transient frequency increase in its contraction rhythmicity and a steady increase in the streaming velocity of its endoplasm.

#### A87-52996

#### SURVEY OF THE VESTIBULUM, AND BEHAVIOR OF XENOPUS LAEVIS LARVAE DEVELOPED DURING A 7-DAYS SPACE FLIGHT

W. BRIEGLEB, J. NEUBERT, A. SCHATZ, T. KLEIN, and B. KRUSE (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 151-156. refs

The paper describes the rough morphology of the vestibulum and the behavior of Shuttle-flown Xenopus laevis larvae. Experiments on the fast-running clinostat reveal that otolith formation is fairly autonomous with regard to gravity. It is noted that the loop swimming behavior of the larvae which was observed about 1 hr after the Space Shuttle landed was also observed in the case of larvae developed on the clinostat and fish flown aboard Apollo capsules.

K.K.

#### A87-52997

CELLULAR DIFFERENTIATION AND PROLIFERATION IN CORN ROOTS GROWN IN MICROGAVITY (BIOCOSMOS 1985) [DIFFERENCIATION ET PROLIFERATION CELLULAIRES DANS DES RACINES DE MAIS CULTIVE EN MICROGRAVITE (BIOCOSMOS 1985)]

N. DARBELLEY, D. DRISS-ECOLE, and G. PERBAL (Paris VI, Universite, France) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 157-160. In French. refs

A cytological study of corn roots (Zea mays) grown aboard Biocosmos 1985 was performed to evaluate the effect of microgavity on cellular differentiation and proliferation, based on the criteria of cellular elongation in the cortical zone and mitotic activity of the meristem. A histological examination reveals differences in the functional root zones of corn roots grown in space and controls grown on earth. Cellular differentiation is found to begin closer to the root cap junction under microgravity conditions. Results also show a reduction by 1/3 in the meristem length, and a two-fold increase in mitotic activity, of the space-grown roots compared to the controls.

#### A87-53012

#### MICROBIAL LIFE AT EXTREMELY LOW NUTRIENT LEVELS

P. HIRSCH (Kiel, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 287-298. DFG-supported research. refs (Contract NSF DPP-83-14180)

It is noted that many microorganisms (oligotrophs) and certain lower fungi grow in distilled water. In the laboratory, these organisms thrive on contaminations of the air. Oligotrophs found in natural locations with extremely low nutrient levels (snow, rainwater pools, springs, free ocean water, and Antarctic rocks and soils) are especially adapted to constant famine; they frequently live attached to surfaces, form polymers and storage products even while starving, and often aggregate. Extreme oligotrophs also occur in generally nutrient-rich environments such as sewage aeration tanks and compost soil; they are thought to survive in nutrient-depauperate microhabitats.

#### A87-53013

## SURVIVAL STRATEGIES OF MICROORGANISMS IN EXTREME SALINE ENVIRONMENTS

J. F. IMHOFF (Bonn, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 299-306. refs

Halophilic representatives are found in all main lines of evolutionary descendence of microbes: in archaebacteria, Gram-negative and Gram-positive eubacteria, and also in eucharyotes. In principle, all halophilic microoganisms have to adapt their surface and membrane structures to their highly ionic environments. Concerning their intracellular compartment, two different strategies have been developed: inorganic ions are largely excluded in some microoganisms while such ions are actively accumulated in others. In particular, the second group of organisms has to adapt the whole metabolic machinery to the highly ionic conditions of several molar salts, whereas in the first group only the outer surface of the cytoplasmic membrane and the extracytoplasmic structures that are in contact with high concentrations of inorganic ions.

#### A87-53533

CHANGES IN THE CARDIAC RHYTHM AND ITS REGULATION DURING ACUTE EXPOSURE TO HEAT [IZMENENIIA SERDECHNOGO RITMA I EGO REGULIATSII PRI OSTROM TEPLOVOM VOZDEISTVII]

T. A. MANSUROV and V. A. RAKHMATULLINA (AN USSR, Institut Fiziologii, Tashkent, Uzbek SSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, July-Aug. 1987, p. 35-39. In Russian. refs

The effects of short exposures (1, 15, 30, and 45 min) to temperatures of 38-40 C and 48-50 C on the cardiac activity of rats were studied by measuring the EKG indices of cardiac rhythm, which were then statistically treated. At 38-40 C, two types of reaction were found to develop: (1) the relaxation of the vagal regulation and an increase of the hypophyseal-adrenal system influence on cardiac activity, and (2) a decrease of the sympathoadrenal effects on the sinus rhythm. At 48-50 C, a decrease of the vagal effects and an increase of the sympathetic ones on the cardiac activity were noted. The course of the development of the regulatory changes were found to depend on the individual rat. In one group, the intensification of the activity of the regulatory cardiac-rhythm mechanisms developed gradually, while in the other group, the intensification started at the beginning of the exposure.

#### A87-53534

THE ACTIVITIES OF ACID AND THE ALKALINE PHOSPHATASES IN TISSUES OF AN ORGANISM SUBJECTED TO COOLING OR OVERHEATING [AKTIVNOST' KISLOI I SHCHELOCHNOI FOSFATAZ TKANEI PRI OKHLAZHDENII I PEREGREVANII ORGANIZMA]

M. SH. USENOVA, Z. IA. DOLGOVA, and E. G. DOLGOV (Ust'-Kamenogorskii Pedagogicheskii Institut, Ust-Kamenogorsk, Kazakh SSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, July-Aug. 1987, p. 39-43. In Russian. refs

The effects of 3-h exposures of rats to cold (+5 C) or elevated temperature (+41 C) on the activities of acid and the alkaline phosphatases in various tissues were studied using biochemical and histochemichal methods for enzyme analysis. The exposure of rats to +5 C resulted in increases of both enzymatic activities in the adrenal glands, but the activities of the brain, liver, myocardium, kidney, lung, and skeletal muscle phosphatases decreased. Overheating led to increases in lung and adrenal gland phosphatases but to decreases of both enzyme activities in all other tissues.

#### A87-53535

PEROXIDATION OF LIPIDS AND THE CONCENTRATION OF ALPHA-TOCOPHEROLS IN THE BLOOD OF RABBITS ADAPTED TO HYPOXIA AND SUBJECTED TO ACUTE DECOMPRESSION [PEREKISNOE OKISLENIE LIPIDOV I KONTSENTRATSIIA ALPHA-TOKOFEROLA V KROVI ADAPTIROVANNYKH K GIPOKSII KROLIKOV PRI OSTROI DEKOMPRESSII]

D. A. SUTKOVOI (AN USSR, Institut Fiziologii, Kiev, Ukrainian SSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, July-Aug. 1987, p. 93-95. In Russian. refs

The effect of acute decompression (simulated by a rapid lowering of an animal) on the lipid peroxidation (LPO) indices and the enzymes of biooxidation systems was studied in rabbits adapted to moderate altitude (7500 m) hypoxia and in nonadapted rabbits. Nonadapted animals exposed repeatedly to decompression occurrences exhibited significant activation of LPO in blood; after the fourth exposure, the concentration of serum malonic dialdehyde (MDA) increased by 40-42 percent and the frequency of spontaneous chemoluminescence (SCL) increased by 177 percent. The concentration of tocopherol decreased to 44 percent after the fourth exposure. Animals adapted to hypoxia exhibited significantly lower LPO, MDA, and SCL increases. Tocopherol concentrations increased after the third and fourth decompression exposures, indicating increased stability of the antioxidation systems.

#### A87-53536

BIOCHEMICAL RECEPTION AND IONIZING IRRADIATION OF AN ORGANISM [BIOKHIMICHESKAIA RETSEPTSIIA I IONIZIRUIUSHCHEE OBLUCHENIE ORGANIZMA]

E. F. ROMANTSEV and E. N. PRIANISHNIKOVA (Ministerstvo Zdravookhraneniia SSSR, Institut Biofiziki, Moscow, USSR) Radiobiologiia (ISSN 0033-8192), vol. 27, May-June 1987, p. 291-296. In Russian. refs

The role of cellular receptors of biochemically active compounds (BAC) in the molecular mechanisms of radiation sickness is examined. Particular attention is given to radiation-induced changes in receptor binding of prostaglandins (PGs), leading to disruptions of cellular metabolism. The nature of potentially radioprotective drugs which would affect BAC receptors, particularly the receptors of PGs, is discussed.

#### A87-53537

CELLULAR MOLECULAR MECHANISMS OF THE BIOLOGICAL EFFECT OF LOW X-RAY DOSES ON ISOLATED MAMMALIAN CELLS [MOLEKULIARNO-KLETOCHNYE MEKHANIZMY BIOLOGICHESKOGO DEISTVIIA MALYKH DOZ RENTGENOVSKOGO IZLUCHENIIA NA IZOLIROVANNYE KLETKI MLEKOPITAIUSHCHIKHI

IU. B. KUDRIASHOV and I. M. PARKHOMENKO (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) Radiobiologiia (ISSN 0033-8192), vol. 27, May-June 1987, p. 297-302. In Russian. refs

#### A87-53538

INVESTIGATION OF THE MECHANISM OF THYMOCYTE DEATH UNDER ULTRAHIGH GAMMA-RAY DOSES [ISSLEDOVANIE MECHANIZMA GIBELI TIMOTSITOV PRI VOZDEISTVII SVERKHVYSOKIKH DOZ GAMMA-IZLUCHENIIA]

N. B. ZVONAREVA, A. A. SEILIEV, S. N. KOLIUBAEVA, E. A. BORISOVA, B. D. ZHIVOTOVSKII (Tsentral'nyi Nauchno-Issledovatel'skii Rentgeno-Radiologicheskii Institut, Leningrad, USSR) et al. Radiobiologiia (ISSN 0033-8192), vol. 27, May-June 1987, p. 319-324. In Russian. refs

#### A87-53539

BIOLOGICAL EFFECTIVENESS OF HELIUM IONS AND PROTONS OF RELATIVISTIC ENERGIES [BIOLOGICHESKAIA EFFECTIVNOST' IONOV GELIIA I PROTONOV RELIATIVIST-SKIKH ENERGII]

B. S. FEDORENKO, N. IA. SAVCHENKO, S. V. VOROZHTSOVA, V. N. GERASIMENKO, A. N. KABACHENKO (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. Radiobiologiia (ISSN 0033-8192), vol. 27, May-June 1987, p. 339-343. In Russian. refs

The relative biological effectiveness (RBE) of accelerated He(2+) and high-energy proton rays encountered by space vehicles was investigated in a laboratory, using gamma-rays of Co-60 and high-energy X-rays for whole-body irradiation of rats and mice and in vitro irradiation of isolated human blood lymphocytes. The RBE coefficients of protons (9 GeV) and accelerated He ions (4 GeV/nucleon) were found to vary from 1.0 to 11.6 and 1.0 to 7.2, respectively, depending upon the object, the estimation criterium, the time of the registration of the biological effect, and the dose.

#### A87-53540

ANALYZING THE STRUCTURAL AND METABOLIC REACTIONS OF THE CENTRAL NERVOUS SYSTEM TO THE COMBINED EFFECTS OF MICROWAVE AND IONIZING RADIATION [STRUKTURNO-METABOLICHESKII ANALIZ REAKTSII TSENTRAL'NOI NERVNOI SISTEMY NA KOMBINIROVANNOE VOZDEISTVIE MIKROVOLNOVOGO I IONIZIRUIUSHCHEGO IZLUCHENII]

V. S. TIKHONCHUK, I. B. USHAKOV, and V. P. FEDOROV (Voronezhskii Gosudarstvennyi Meditsinskii Institut, Voronezh, USSR) Radiobiologiia (ISSN 0033-8192), vol. 27, May-June 1987, p. 361-365. In Russian. refs

The effects of microwaves and gamma rays on the structure and metabolism of the central nervous system (CNS) were studied in rats subjected to 20-s-long whole-body irradiation by microwaves and/or to Co-60 irradiation of the head area. Structural changes undergone by the brain cortex were evaluated by estimating changes in the numbers of mast cells and the volume of neurocyte nuclei in various regions of the brain. To assess metabolic changes, the enzymatic activity of acid phosphatase in the sensory-motor cortex and the plasma contents of Na, K, and water were measured. Both structural and functional changes in CNS were found to be the same after both microwave and gamma irradiation. When the two types of radiation were delivered in combination, the sequence of delivery was important: when gamma-rays were delivered prior to the microwave radiation, the effect was synergistic; when the exposure to gamma rays followed that by microwaves, some effects were antagonistic.

A87-53615\* Pennsylvania State Univ., University Park.

AN ENZYME IMMUNOASSAY FOR RAT GROWTH HORMONE -APPLICATIONS TO THE STUDY OF GROWTH HORMONE

MARIANNE A. FARRINGTON and W. C. HYMER (Pennsylvania State University, University Park) Life Sciences (ISSN 0024-3205), vol. 40, 1987, p. 2479-2488. refs (Contract NCC2-287; NAS9-17416)

A sensitive and specific competitive enzyme immunoassay for rat growth hormone (GH) is described and its use in the detection of GH variants is demonstrated. In the present assay, soluble GH and GH adsorbed to a solid-phase support compete for monkey anti-GH antibody binding sites. The immobilized antibody-GH complex is detected and quantified using goat antimonkey immunoglobin G covalently conjugated to horseradish peroxidase. It is noted that the assay can be performed in 27 hours and that sensitivities in the range of 0.19 to 25 ng can be obtained in the region of 10 to 90 percent binding.

#### A87-53619\* Pennsylvania State Univ., University Park. FLOW CYTOMETRIC IMMUNOFLUORESCENCE OF RAT ANTERIOR PITUITARY CELLS

J. MICHAEL HATFIELD and W. C. HYMER (Pennsylvania State University, University Park) Cytometry (ISSN 0196-4763), vol. 6, 1985, p. 137-142. refs (Contract NIH-CA-23248; NAS9-15566)

A flow cytometric immunofluorescence technique was developed for the quantification of growth hormone, prolactin, and luteinizing hormone producing cells. The procedure is based on indirect-immunofluorescence of intracellular hormone using an EPICS V cell sorter and can objectively count 50,000 cells in about 3 minutes. It can be used to study the dynamics of pituitary cell populations under various physiological and pharmacological conditions.

A87-53624\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IMMUNOCYTOCHEMICAL LOCALIZATION OF GLUTAMIC ACID **DECARBOXYLASE (GAD) AND GLUTAMINE SYNTHETASE (GS)** IN THE AREA POSTREMA OF THE CAT. LIGHT AND ELECTRON MICROSCOPY

FERNANDO E. D'AMELIO, WILLIAM R. MEHLER, MICHAEL A. GIBBS (NASA, Ames Research Center, Moffett Field, CA), LAWRENCE F. ENG (USVA, Medical Center, Palo Alto, CA), and JANG-YEN WU (Pennsylvania State University, Hershey) Research (ISSN 0006-8993), vol. 410, 1987, p. 232-244. (Contract NCC2-282; NCA2-OR-675-303; NIH-NS-11632; NIH-NS-20978)

Morphological evidence is presented of the existence of the putative neurotransmitter gamma-aminobutyric acid (GABA) in axon terminals and of glutamine synthetase (GS) in ependymoglial cells and astroglial components of the area postrema (AP) of the cat. Purified antiserum directed against the GABA biosynthetic enzyme glutamic acid decarboxylase (GAD) and GS antiserum were used. The results showed that punctate structures of variable size corresponding to axon terminals exhibited GAD-immunoreactivity and were distributed in varying densities. The greatest accumulation occurred in the caudal and middle segment of the AP and particularly in the area subpostrema, where the aggregation of terminals was extremely dense. The presence of both profiles GAD-immunoreactive and GS-immunostained ependymoglial cells and astrocytes in the AP provide further evidence of the functional correlation between the two enzymes.

C.D.

A87-53629\* Pennsylvania State Univ., University Park. EFFECT OF PITUITARY HOLLOW FIBER UNITS AND THYROID SUPPLEMENTATION ON GROWTH IN THE LITTLE MOUSE

JOHN E. HARKNESS, W. C. HYMER, JAMES L. ROSENBERGER (Pennsylvania State University, University Park), and RICHARD E. GRINDELAND (NASA, Ames Research Center, Moffett Field, CA) Society for Experimental Biology and Medicine, Proceedings (ISSN 0037-9727), vol. 177, 1984, p. 312-317. Research supported by the Pennsylvania State University. refs (Contract NCAZ-05-589-101)

It is shown that the implantation of encapsulated pituitary cells into heterozygous lit/+ mice inhibited the average percentage change in weight gain as compared to controls. However, homozygous lit/lit mice receiving cell-filled capsules consistently had higher percentage weight gains than their control counterparts. It was also found that thyroid-supplemented mutant mice with pituitary cell implants had significantly higher organ and carcass weights than other mutant groups.

#### A87-53649

FLOW CYTOMETRIC ANALYSIS AND SORTING OF LIVE MALE RAT ANTERIOR PITUITARY CELL TYPES BY FORWARD ANGLE AND PERPENDICULAR LIGHT SCATTER

J. MICHAEL HATFIELD and W. C. HYMER (Pennsylvania State University, University Park) Endocrinology (ISSN 0013-7227), vol. 119, no. 6, 1986, p. 2670-2682. refs (Contract PHS-CA-23248)

The use of light scatter signals produced by live male rat anterior pituitary cells in the flow cytometer as markers to aid in the identification and separation of different hormone-containing cell types was investigated. The typical light scatter pattern had three ridges in the forward angle light scatter (FALS) perpendicular light scatter (PLS) bivariate cell distribution. FALS signals could be correlated with the size of different cell types and PLS signals with their content of cytoplasmic secretory granules. Agranular cells dominated the low PLS ridge while moderately granulated PRL cells and heavily granulated GH cells dominated the medium and high PLS ridges, respectively. Inclusion of dopamine in the pituitary gland dissociation medium increased the intensity of the PLS signals of a large population of cells.

#### A87-53650

FLOW CYTOMETRIC ANALYSIS AND SORTING OF LIVE FEMALE RAT ANTERIOR PITUITARY CELL TYPES BY FORWARD ANGLE AND PERPENDICULAR LIGHT SCATTER -**EFFECT OF 17 BETA-ESTRADIOL** 

J. MICHAEL HATFIELD and W. C. HYMER (Pennsylvania State University, University Park) Endocrinology (ISSN 0013-7227), vol. 119, no. 6, 1986, p. 2683-2694. refs (Contract PHS-CA-23248)

Studies were conducted to determine the extent of 17 beta-estradiol (E2)-induced changes in the laser light scatter signals of pituitary mammotrophs after the delivery of physiological concentrations of E2 to ovariectomized rats. Changes were found in the forward angle light scatter (FALS) and perpendicular light scatter signals of anterior pituitary lobe cells. The majority of the cells showing increased FALS signals were mammotrophs. It is noted that physiological levels of E2 produced small but consistent elevations in the percentage of somatotrophs at all treatment times tested.

#### A87-53828

POSSIBLE BIOLOGICAL ORIGIN OF BANDED IRON-FORMA-TIONS FROM HYDROTHERMAL SOLUTIONS

NILS G. HOLM (Stockholm, Universitet, Sweden) Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 229-250. Research supported by the Naturvetenskapliga Forskningsradet. refs

The origin of banded Fe-formations is discussed in the framework of a combined hydrothermal/biogenic model which is based on the distribution of trace elements in modern biogenic metalliferous sediments and Proterozoic banded Fe-formations (which are characteristically poor in trace elments), as well as on reduced carbon isotope data. On the basis of these data it is argued that the Fe banding was caused by periods of slow precipitations of oxidized iron from hot hydrothermal solutions alternating with periods of precipitation of silica from cool hydrothermal solutions. Slow oxidation of iron was brought about in low-oxygen hydrothermal environments by microaerophilic chemolithotrophic bacteria inhabiting these environments.

#### A87-53830\* California Univ., La Jolla.

#### YIELDS FOR HYDROGEN CYANIDE AND FORMALDEHYDE SYNTHESES - THE HCN AND AMINO ACID CONCENTRATIONS IN THE PRIMITIVE OCEAN

ROSCOE STRIBLING and STANLEY L. MILLER (California, University, La Jolla) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 261-273.

(Contract NAGW-20)

Simulated prebiotic atmospheres containing either CH4, CO, or CO2, in addition to N2, H2O, and variable amounts of H2, were subjected to the spark from a high-frequency Tesla coil, and the energy yields for the syntheses of HCN and H2CO were estimated from periodic (every two days) measurements of the compound concentrations. The mixtures with CH4 were found to yield the highest amounts of HCN, whereas the CO mixtures produced the highest yields of H2CO. These results model atmospheric corona discharges. From the yearly energy yields calculated and the corona discharge available on the earth, the yearly production rate of HCN was estimated; using data on the HCN production rates and the experimental rates of decomposition of amino acids through the submarine vents, the steady state amino acid production rate in the primitive ocean was calculated to be about 10 nmoles/sq cm per year.

#### **ENERGY** METABOLISM OF A THERMOACIDOPHILIC ARCHAEBACTERIUM, SULFOLOBUS ACIDOCALDARIUS

TAKAYOSHI WAKAGI and TAIRO OSHIMA (Tokyo Institute of Technology, Yokohama, Japan) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p.

Membrane-bound factors of the oxidative phosphorylation system of Sulfolobus acidocaldarius archaebacterium were studied. Although cytochrome c was lacking in this organism, the respiratory poisons azide and cyanide killed the cells, suggesting the presence of a terminal oxidase (cytochrome a) of the electron transport system. NADH dehydrogenase was purified from the crude cell extracts; it was found to transfer electrons from NADH to caldariellaquinone (a unique quinone in the genus Sulfolobus) suggesting that this enzyme and the quinone are members of the S. acidocaldarius respiratory chain. Two types of ATPase were found in the membrane fraction: one is active at neutral pH and is slightly activated by sulfate; the other is an acid apyrase and is inhibited by sulfate.

#### A87-53843

## ORIGIN AND EVOLUTION OF PHOTOSYNTHETIC REACTION

JOHN M. OLSON (Odense Universitet, Denmark) and BEVERLY K. PIERSON (Puget Sound, University, Tacoma, WA) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 419-430. refs
The origin and the early evolution of photosynthetic reaction

centers (RCs) are discussed. It is proposed that the prototype RC may have used a porphyrin molecule and a Fe-S center associated with small peptides to create a charge separation across the primitive cell membrane. The precursor of all contemporary RCs is considered to have contained chlorophyll a (Chl a), as both primary electron donor and initial electron acceptor, and a Fe-S center as a secondary acceptor (RC-1 type). The continued competition for light has stimulated the evolution of BChl g and, subsequently, of BChl a from Chl a; the competition for reductants for the CO2-fixation process has stimulated evolution of a second RC, RC-2. The organisms containing ChI a, RC-1, and RC-2 have added a water-splitting enzyme to RC-2 (between 3.0 and 2.5 Gyr ago) in order to use H2O in place of the ferrous hydroxide ion as an electron donor for autotrophic photosynthesis, thus completing foundation for the contemporary oxygen-evolving photosynthesis by cyanobacteria and chloroplasts.

#### A87-54091

#### A SMALL CATALYTIC OLIGORIBONUCLEOTIDE

OLKE C. UHLENBECK (Colorado, University, Boulder) Nature (ISSN 0028-0836), vol. 328, Aug. 13, 1987, p. 596-600. NIH-supported research. refs

A 19-nucleotide RNA fragment can cause rapid, highly specific cleavage of a 24-nucleotide RNA fragment under physiological conditions. Because each 19-mer can participate in many cleavage reactions, this molecule has all the properties associated with an RNA enzyme.

N87-29077\*# Santa Clara Univ., Calif. Dept. of Biology.

GROWTH HORMONE SECRETION DURING SPACE FLIGHT AND EVALUATION OF THE PHYSIOLOGICAL RESPONSES OF ANIMALS HELD IN THE RESEARCH ANIMAL HOLDING FACILITY Final Report, Mar. 1982 - Jul. 1986

THOMAS N. FAST, RICHARD GRINDELAND, WILLIAM MEHLER, and JIRO OYAMA Sep. 1987 6 p

(Contract NCC2-180)

(NASA-CR-181344; NAS 1.26:181344) Avail: NTIS HC A02/MF A01 CSCL 06C

The spaceflight of the Research Animal Holding Facility (RAHF) on the Space Laboratory 3 (SL 3) provided the opportunity to evaluate the suitability of the RAHF for housing and maintaining experimental animals during spaceflight, and to determine changes in the secretion of growth hormone during spaceflight. Using ground-based studies the following were investigated: the optimum conditions for creating gravitational force on space flight animals; neural pathways that may play a role in the space flight syndrome; and the time course of muscle atrophy due to hypodynamia and hypokenesia in hindlimb-suspended animals and the role of growth hormone in these processes.

## N87-29078# Los Alamos National Lab., N. Mex. WORK PERFORMANCE EVALUATION USING THE EXERCISING

D. M. STAVERT and B. E. LEHNERT 1987 5 p Presented at the 6th Medical Chemical Defense Bioscience Review, Baltimore, Md., 1 Aug. 1987 (Contract W-7405-ENG-36)

(DE87-010131; LA-UR-87-1748; CONF-870887-1) Avail: NTIS HC A02/MF A01

A treadmill-metabolic chamber system and a stress testing protocol have been developed to evaluate aerobic work performance on exercising rats that have inhaled toxic substances. The chamber with an enclosed treadmill provides the means to measure the physiologic status of rats during maximal work intensities in terms of O2 consumption (V sub O2) and CO2 production (V sub CO2). The metabolic chamber can also accommodate instrumented rats for more detailed analyses of their cardiopulmonary status, e.g., ECG, cardiac output, arterial blood gases and pH, and arterial and venous blood pressures. For such studies, an arterial/venous catheter preparation is required. Because of the severe metabolic alterations after such surgery, a post surgical recovery strategy using hyperalimentation was developed to ensure maximal performance of instrumented animals during stress testing. Actual work performance studies are conducted using an eight minute stress test protocol in which the rat is subjected to increasing external work. The metabolic state of the animal is measured from resting levels to maximum oxygen consumption (V sub O2 max). The V sub O2 max has been shown

#### 51 LIFE SCIENCES (GENERAL)

to be reproducible in individual rats and is a sensitive indicator of oxidant gas-induced pulmonary damage.

N87-29079\*# RCA Government Services, Washington, D.C. USSR SPACE LIFE SCIENCES DIGEST, ISSUE 13

LYDIA RAZRAN HOOKE, ed., VICTORIA GARSHNEK, RONALD TEETER, ed., MIKE RADTKE, ed., and JOSEPH ROWE, ed. (Library of Congress, Washington, D. C.) NASA Sep. 1987 122 p

(Contract NASW-3676)

(NASA-CR-3922(15); NAS 1.26:3922(15)) Avail: NTIS HC

A06/MF A01 CSCL 06C

This is the thirteenth issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 39 papers recently published in Russian-language periodicals and bound collections. two papers delivered at an international life sciences symposium, and three new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. Also included is a review of a recent Soviet-French symposium on Space Cytology. Current Soviet Life Sciences titles available in English are cited. The materials included in this issue have been identified as relevant to 31 areas of aerospace medicine and space biology. These areas are: adaptation, biological rhythms, body fluids, botany, cardiovascular and respiratory systems, cosmonaut training, cytology, developmental biology, endocrinology, enzymology, equipment and instrumentation, gastrointestinal systems, genetics, habitability and environment effects, hematology, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, personnel selection, psychology, radiobiology, space biology, and space medicine.

N87-29087# Joint Publications Research Service, Arlington, Va. ADAPTIVE AND CUMULATIVE EFFECTS ON DOGS OF REGULAR EXPOSURE TO +GZ ACCELERATIONS

R. A. VARTBARONOV, G. D. GLOD, N. N. UGLOVA, I. S. ROLIK, I. G. KRASNYKH, V. G. NOVIKOV, and N. A. GAYDAMAKIN In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 51-56 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 37-40

Avail: NTIS HC A08/MF A01

The development of adaptive and cumulative effects was investigated in 13 noninbred dogs regularly exposed to plus Gz acceleration. Group 1 dogs were exposed 3 to 4 times a week for 2 months and Group 2 dogs were exposed 1 to 2 times a week for 5 months. The tolerance threshold was evaluated with respect to ECG abnormalities. The study of circulation reactions and acceleration tolerance threshold revealed the predominant development of adaptive changes that were more distinct in Group 2 dogs. Cumulative effects in the form of functional disorders of pulmonary vessels occurred in all experimental dogs, but less frequently in Group 2 dogs. Morphological lesions of the lung tissue developed in Group 1 animals after 2 to 3 exposures and in Group 2 animals after 2 to 3 months, the incidence rate being lower in the latter group. These findings suggest that adaptive and cumulative effects in response to regular exposures to threshold plus Gz acceleration develop more or less in parallel.

Author

N87-29091# Joint Publications Research Service, Arlington, Va. STATUS OF ALPHA 1-ADRENERGIC REGULATION OF STROKE **VOLUME IN HYPOKINETIC RATS** 

A. S. CHINKIN In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 75-80 15 Jun. 1987 ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p

Avail: NTIS HC A08/MF A01

The positive effect of phenylephrine (PE) on stroke volume was 3 to 5 times weaker in the rats exposed to hypokinesia for 30 days as compared to the controls. An investigation suggested that the activity of alpha 1-adrenoreceptors involved in the actualization of positive effects of agonists on stroke volume is considerably lower during hypokinesia.

N87-29092# Joint Publications Research Service, Arlington, Va. ADAPTABILITY OF THE RAT HYPOKINETIC HEART TO AFTERLOAD, AND THE ROLE OF NERVOUS REGULATION

V. I. KUZNETSOV and G. M. PRUSS In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 81-85 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, Mar. - Apr. 1987 p 55-58

Avail: NTIS HC A08/MF A01

Adaptation of the heart of hypokinetic rats to sustained afterload and the role of nervous regulation in this process is investigated. It was concluded that cardiac resistance of the hypokinetic rats to afterload is higher than in the intact rats with coarctation of the aorta. On the other hand, afterload reduces the hypokinesia induced increase in the contractility function. In addition to the nervous influences (sympathic), intracardiac factors play an important role in the mechanisms of adaptation of the heart to hypokinesia and of the hypokinetic heart to afterload.

N87-29095# Joint Publications Research Service, Arlington, Va. DYNAMICS OF NONCOLLAGEN PROTEIN METABOLISM IN DOGS EXPOSED TO LOW DOSES OF CHRONIC GAMMA **RADIATION FOR 6 YEARS** 

Z. A. VINOGRADOVA In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 97-101 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 66-69

Avail: NTIS HC A08/MF A01

The effect of chronic and acute (as compared to the total dose) gamma irradiation in the range 2.5 to 7.5 Gy on metabolism of noncollagen proteins (NCP) in various tissues and peripheral blood of dogs was investigated. Metabolic disorders of NCPs in tissues were found. Their high level was indicative of enhanced collagen formation in the irradiated animals. With respect to the NCP content, 3 to 14 days after acute irradiation in the dose of 0.42 Gy there was a change in the body which was independent of the total irradiation dose.

N87-29101# Joint Publications Research Service, Arlington, Va. CHANGES IN RAT HEMOPOIESIS AS A RESULT OF THE COMBINED EFFECT OF ACCELERATIONS, RADIATION AND RADIATION-MODIFYING AGENTS

V. B. TENCHOVA and T. P. PANTEV In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 129-131 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 85-86

Avail: NTIS HC A08/MF A01

Spaceflight factors lead to a number of changes in hemopoiesis, the severity of which depends on the nature, duration and order of exposure to such factors. Accelerations, weightlessness, vibration and certain other factors can modify not only radiation lesions, but pharmacotoxic and protective properties of radioprotective agents and substances for biological protection. Cellularity of bone marrow and the spleen is one of the indicators of the radiation-protective effect of chemical agents and substances that enhance natural resistance. The objective here is to investigate changes in overall cellularity of bone marrow, weight and cellularity of the spleen of rats subjected to the combination of acceleration and radiation, as well as the possibility of modifying these changes with eleuterococcus and the radioprotective agent adeturon.

Author

#### N87-29103# Joint Publications Research Service, Arlington, Va. EFFECT OF COOLING AND FREEZING ON MICROFLORA IN WATER REGENERATED FROM ATMOSPHERIC MOISTURE CONDENSATE

M. I. SHIKINA, S. V. CHIZHOV, and N. B. KOLESINA JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), no. 21, no. 2, Mar. - Apr. 1987 p 87-89 Avail: NTIS HC A08/MF A01

The objective was to test the effect of low temperature on the growth and development of microflora in a condensate of atmospheric moisture and regenerated water. The findings were indicative of instability of microflora in a condensate of atmospheric moisture and regenerated water at low temperatures in a closed environment. Author

N87-30022# Utah Univ., Salt Lake City. Dept. of Electrical Engineering.

#### BIOLOGICAL EFFECTS OF MILLIMETER-WAVE IRRADIATION Final Report, 15 Apr. 1984 - 31 Mar. 1986

OM P. GANDHI, DOUGLAS W. HILL, LUCIANO FURIA, MAGDY F. ISKANDER, and DEEPAK GHODGAONKAR Apr. 1987 93 p. (Contract F33615-84-K-0610)

(AD-A182890; UTEC-86-095; USAFSAM-TR-86-44) Avail: NTIS HC A05/MF A01 CSCL 06G

Experiments were conducted to verify the reported high degree of sensitivity of growth rates of yeast cultures to millimeter-wave irradiation in the band 41.650 to 41.798 GHz. A new irradiation chamber was designed and built to allow simultaneous irradiation and sham irradiation of recirculating suspension of saccharomyces cerevisiae maintained with a temperature difference of less than 0.01 C. No difference larger than plus or minus 4% was ever detected in the growth rates at any of the highly stabilized (within plus or minus 50 Hz) irradiation frequencies for which the effects had been reported by earlier workers. Experiments were also performed to determine the Raman Spectra of cultures of bacillus megaterium to investigate if these are dependent on the stage of their life cycle. The results were negative. A further study to investigate the ability of millimeter waves to induce conformational changes in lipid bilayers of dipalmitoyl phosphatidycholine (DPPC) liposomes below and above the transition temperature of 41 C also gave negative results. For these experiments the conformational characteristics of the liposomes were evaluated using Raman spectra with and without mm-wave irradiation at 41.650 GHz.

N87-30023# Air Force Inst. of Tech., Wright-Patterson AFB,

Ohio. School of Engineering.

AN ELECTRICAL CIRCUIT MODEL OF THE INTERFACE
BETWEEN AN ELECTRODE AND THE ELECTROLYTIC MEDIUM OF THE CORTEX M.S. Thesis

JEFFREY M. SEDLAK 31 Jul. 1987 383 p

(AD-A183204; AFIT/GE/EE/86D-48) Avail: NTIS HC A17/MF A01 CSCL 09A

Former research of the visual processes that occur at the cortex of mammals concentrated on the task of the design and implantation of a multielectrode array, the AFIT brain chip. Despite the importance of refining these activities, questions were generated from data collected during the first implant that need to be resolved before the next implant into a higher-level primate is attempted. The specific nature of the interface between the electrodes and the electrolytic medium at the cortex is critical to understanding and interpreting data collected during an implantation. The primary thrust of this research is to propose a qualitative model of the electrode/electrolyte interface and then to calculate the quantitative parameters of that model by immersing brain chips into a simulated electrolyte and recording empirical data. The secondary focus of this research is to investigate the limiting effect of the electrode/electrolyte interface upon the maximal scan rate or the multielectrode array.

N87-30024# Washington Univ., Seattle. Bioelectromagnetics Research Lab.

AFFERENT MECHANISMS OF MICROWAVE-INDUCED BIOLOGICAL EFFECTS Final Report, Jun. 1980 - Aug. 1987 H. LAI, A. HORITA, C. K. CHOU, and A. W. GUY 12 Aug. 1987

(Contract N00014-80-C-0354; DA PROJ. RR0-4108)

(AD-A183562) Avail: NTIS HC A02/MF A01 CSCL 06G

Effects of low-level microwave irradiation on neurological function were investigated in the rat. Results can be summarized in the following statements: (1) acute exposure effects the response of an animal to psychoactive drugs and changes cholinergic activity in the brain; (2) effects of microwaves are classically conditionable to environmental cues after repeated exposure. Tolerance can also develop after repeated exposure; and (3) endogenous opioids play a mediating role in certain neurological effects of microwaves. These data further our understanding on the neurological effects of microwave exposure and may have important implications in certain occupational situations in which repeated exposure to low-level microwaves is unavoidable.

#### **52**

#### **AEROSPACE MEDICINE**

Includes physiological factors; biological effects of radiation; and weightlessness.

#### A87-50948

THE EFFECT OF HIGH TEMPERATURE ON THE FUNCTIONAL CONDITION AND WORK CAPACITY OF AN ORGANISM (VLIIANIE VYSOKOI TEMPERATURY NA FUNKTSIONAL'NOE SOSTOIANIE ORGANIZMA I RABOTOSPOSOBNOST']

N. D. BAGROVA and V. P. KOVALENKO Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), April 1987, p. 35, 36. In Russian.

Evidence demonstrating the deleterious effects of high temperature, especially in combination with high humidity, on the physiological state of an organism and on the ability to do mental and physical work is discussed. The capacity for mental work begins to deteriorate already at 27-31 C, whereas the decrease in the capacity for physical work appears to begin at 35-36 deg. The effect of high temperature (40-70 C) and humidity (45-50 percent) on work capacity was studied. It was found that even insignificant physical loads lead to large increases in heart rate (to 170-190 beats/min) and rectal temperature (to 38.3-38.6 C) and to a rapid drop of work capacity. The use of pulse rate as an monitor of physiological condition is suggested; workers performing physical assignments in hot environments should stop working when the pulse rate reaches 140 counts/min. At 100 counts/min. the work can be resumed. I.S.

#### A87-50950

THE EFFECT OF ELEVATED OXYGEN AND CARBON DIOXIDE CONTENTS IN AIR ON THE CONDITION OF THE CARDIORESPIRATORY SYSTEM [VLIIANIE POVYSHENNOGO SODERZHANIIA V VOZDUSHNOI SREDE KISLORODA I UGLEKISLOGO GAZA NA SOSTOIANIE KARDIORESPIRATORNOI SISTEMY]

V. G. ALTUKHOV, M. A. GREBENIK, and A. A. SHAPOVOLOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), April 1987, p. 39, 40. In Russian.

The effect of prolonged (up to 4 months) breathing of an artificial atmosphere (AA) containing 21.3-26.3 kPa O2 and 0.1-0.4 kPa CO2 on the parameters of the cardiorespiratory system was studied in 20 volunteers, divided into two equal groups: an experimental group, which exercised on a bicycle ergometer three times a week, and a nonexercising control group. With increasing time in the AA, the subjects of both groups exhibited symptoms typical of moderate hyperoxia: decreases in pulse rate and minute blood volume, O2 intake and CO2 elimination, respiratory coefficient, and energy consumption at rest. At the same time, the coefficient of O2 utilization, the minimal arterial pressure, and the peripheral vessel resistance increased. Exercise decreased these deleterious effects.

#### A87-51163

## IMPROVING VISUAL PERFORMANCE THROUGH VOLITIONAL FOCUS CONTROL

STANLEY N. ROSCOE and DONALD H. COUCHMAN (Illiana Aviation Sciences, Las Cruces, NM) Human Factors (ISSN 0018-7208), vol. 29, June 1987, p. 311-325. USAF-sponsored research. refs

Nine undergraduate students were trained to control eye accommodation volitionally and, by exercising that acquired ability, to improve by varying amounts their visual acuity, contrast sensitivity, and flash target resolution. Six of the nine received auditory biofeedback of focusing responses measured automatically by a complex infrared tracking optometer and monocular focus stimulator, whereas the remaining three used a relatively simple polarized Vernier optometer that provides visual feedback of eye accommodation, and an even simpler binocular focus stimulator. Performance improvements were elicited by both methods, but larger gains were attained in far less time with the simpler approach, in which training is mainly self-administered.

#### A87-51178

#### SOME CHARACTERISTICS OF PERIPHERAL VISION

TADAHIKO FUKUDA (Japan Broadcasting Corp., Visual Science Research Div., Tokyo) NHK Technical Monograph (ISSN 0077-2631), Jan. 1987, p. 3-38. refs

Some of the characteristics of peripheral vision were investigated not only as a pure way of understanding the visual system but also as a basis for wide angle display and other technical applications. Flicker perimetry and flicker perception are dealt with, and relationship between the conditions under which motion and retinal location can be perceived is given. The function of the visual field in figure perception and character recognition, and the relationship between recognition of character string and the lateral interference effect are also dealt with. Finally, information capacity for various characters is given with the discussion on lateral interference effect.

#### A87-52086

#### DOES CONE POSITIONAL DISORDER LIMIT RESOLUTION?

JOY HIRSCH and W. H. MILLER (Yale University, New Haven, CT) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1481-1492. Research supported by the Connecticut Lions Eye Research Foundation Association.

(Contract F49620-83-C-0026; NIH-EY-00785; NIH-EY-03196; NIH-EY-00167)

The retinal sampling mosaic for a monkey eye is determined. Consideration is given to the possible consequences of both cone spacing and positional jitter on visual resolution. It is found that

the sampling theorem based on average spacing overestimates the pooled estimate of visual acuity from the foveal edge to about 5 deg; this is probably due to the sampling noise caused by orientation and spacing disorder combined with demodulation as a result of the optics of the eye.

K.K.

A87-52087\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### **CONE SAMPLING ARRAY MODELS**

ALBERT J. AHUMADA, JR. (NASA, Ames Research Center, Moffett Field, CA) and ALLEN POIRSON (Stanford University, CA) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1493-1502. refs

A model is described for positioning cones in the retina. Each cone has a circular disk of influence, and the disks are tightly packed outward from the center. This model has three parameters that can vary with eccentricity: the mean radius of the cone disk, the standard deviation of the cone disk radius, and the standard deviation of postpacking jitter. Estimates for these parameters out to 1.6 deg are found by using measurements reported by Hirsch and Hylton (1985) and Hirsch and Miller (1987) of the positions of the cone inner segments of an adult macaque. The estimation is based on fitting measures of variation in local intercone distances, and the fit to these measures is good.

#### A87-52088

## PSYCHOPHYSICAL ESTIMATE OF EXTRAFOVEAL CONE SPACING

NANCY J. COLETTA and DAVID R. WILLIAMS (Rochester, University, NY) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1503-1513. refs

(Contract AF-AFOSR-85-0019; NIH-EY-04367; NIH-EY-01319; NIH-EY-00269)

In the extrafoveal retina, interference fringes at spatial frequencies higher than the resolution limit look like two-dimensional spatial noise, the origin of which has not been firmly established. It is shown that over a limited range of high spatial frequencies this noise takes on a striated appearance, with the striations running perpendicular to the true fringe orientation. A model of cone aliasing based on anatomical measurements of extrafoveal cone position predicts that this orientation reversal should occur when the period of the interference fringe roughly equals the spacing between cones, i.e., when the fringe spatial frequency is about twice the cone Nyquist frequency. Psychophysical measurements of the orientation reversal at retinal eccentricities from 0.75 to 10 deg are in quantitative agreement with this prediction. This agreement implies that at least part of the spatial noise observed under these conditions results from aliasing by the cone mosaic. The orientation reversal provides a psychophysical method for estimating spacing in less regular mosaics, complementing another psychophysical technique for measuring spacing in the more regular mosaic of foveal cones (Williams, 1985).

#### A87-52089

#### CONE SPACING AND THE VISUAL RESOLUTION LIMIT

DAVID R. WILLIAMS and NANCY J. COLETTA (Rochester, University, NY) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1514-1523. refs

(Contract AF-AFOSR-85-0019; NIH-EY-04367; NIH-EY-00269; NIH-EY-01319)

It is commonly assumed that the visual resolution limit must be equal to or less than the Nyquist frequency of the cone mosaic. However, under some conditions, observers can see fine patterns at the correct orientation when viewing interference fringes with spatial frequencies that are as much as about 1.5 times higher than the nominal Nyquist frequency of the underlying cone mosaic. The existence of this visual ability demands a closer scrutiny of the sampling effects of the cone mosaic and the information that is sufficient for an observer to resolve a sinusoidal grating. The Nyquist frequency specifies which images can be reconstructured

without aliasing by an imaging system that samples discretely. However, it is not a theoretical upper bound for psychophysical measures of visual resolution because the observer's criteria for resolving sinusoidal gratings are less stringent than the criteria specified by the sampling theorem for perfect, alias-free image reconstruction.

#### A87-52090

## PERIPHERAL HYPERACUITY - ISOECCENTRIC BISECTION IS BETTER THAN RADIAL BISECTION

YEN L. YAP, DENNIS M. LEVI, and STANLEY A. KLEIN (Houston, University, TX) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1562-1567. Research supported by the American Optometric Foundation. refs

(Contract NIH-R01-EY-01728; NIH-R01-EY-04776)

Performance of three-dot bisection was determined as a function of orientation for a variety of feature separations and field meridians at eccentricities of 0-10 deg for two observers. The dot stimuli and separations were scaled in size to compensate for eccentricity. The precision of three-dot bisection was found to depend on the direction of test-feature offset. In the fovea, horizontal and vertical bisections were better than oblique bisections, while at eccentricities of 5-20 deg, isoeccentric (on a tangent to a circle of a given eccentricity) bisection was better than radial bisection. The direction of offset was more important than the orientation of the stimulus. Large separations showed a stronger effect than small separations. The anisotropy of bisection appears different from the meridional effect for resolution and is unlikely to be simply related to a local anisotropy of the cortical magnification **Author** factor.

#### A87-52091

#### **CORTICAL MAGNIFICATION AND PERIPHERAL VISION**

VEIJO VIRSU, RISTO NASANEN, and KARI OSMOVIITA (Helsinki, University, Finland) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1568-1578. Research supported by the Academy of Finland. refs

In a generalized form, the cortical magnification theory of peripheral vision predicts that the thresholds of any visual stimuli are similar across the whole visual field if the cortical stimulus representations calculated by means of the cortical magnification factor are similar independently of eccentricity. Failures of the theory in spatial vision were analyzed, and the theory was tested with five visual acuity tasks and two hyperacuity tasks. Almost all increases in thresholds with eccentricity were explained by the theory in five of these tasks, which included the two-dot Vernier hyperacuity test, the measurement of visual acuities with gratings, the Snellen E test, and two acuity tests that required either separation between dots or discrimination between mirror-symmetric forms. The two-dot Vernier thresholds could be explained as a special case of orientation discrimination, and orientation discrimination at different eccentricities was in agreement with the cortical magnification theory. The increase of thresholds in peripheral vision was larger than predicted by the theory in the Landolt visual acuity and bisection hyperacuity tests. possibly because of retinal undersampling. Author

#### A87-52093

#### **CONTRAST DISCRIMINATION IN PERIPHERAL VISION**

GORDON E. LEGGE (Minnesota, University, Minneapolis) and DANIEL KERSTEN (Brown University, Providence, RI) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1594-1598. refs (Contract NIH-EY-02857)

Properties of contrast discrimination in central and peripheral vision are determined. Forced-choice procedures were used to measure contrast-increment thresholds as a fuction of pedestal contrast. Two-cycle/deg Gaussian-windowed sine-wave grating patches centered at retinal loci ranging from 10 deg nasal to 20 deg temporal on the horizontal meridian are used as stimuli. It is found that, after scaling by the local contrast sensitivity, properties

of contrast discrimination are qualitatively and quantitatively similar in the range of 0 to 20 deg on the retina. It is concluded that contrast coding mechanisms are similar in central and periperal vision.

K.K.

#### A87-52094

# SPATIOTEMPORAL PROPERTIES OF GRATING MOTION DETECTION IN THE CENTER AND THE PERIPHERY OF THE VISUAL FIELD

M. J. WRIGHT (Brunel University, Uxbridge, England) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1627-1633. refs

#### A87-52095

#### **ACCOMMODATION TO STIMULI IN PERIPHERAL VISION**

YUANCHAO GU and GORDON E. LEGGE (Minnesota, University, Minneapolis) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1681-1687. refs

(Contract NIH-EY-02857)

Can targets in peripheral vision elicit accommodation responses? A laser optometer was used to measure monocular steady-state accommodation for stimuli at retinal eccentricities ranging from 1 to 30 deg. The optical distance from the eye to the stimulus was varied from 0 to -6 D by introducing lenses in front of the eye. The accommodative response was plotted as a function of optical distance to produce an accommodative stimulus-response function. The magnitude of accommodative response was defined as the difference between the maximum and minimum values of this function. The magnitude declined from 4 D at 1 deg to 1-2 D at 30 deg eccentricity. The relation of the magnitude of accomodative response in peripheral vision to changes in acuity, contrast sensitivity, and depth of focus are considered. The role played by convergence accommodation is also discussed. Author

#### A87-52218

## NEUROMUSCULAR AND MECHANICAL RESPONSES TO INSPIRATORY RESISTIVE LOADING DURING SLEEP

DAVID W. HUDGEL, MARIBETH MULHOLLAND, and CURTIS HENDRICKS (Case Western Reserve University; Cleveland Metropolitan General Hospital, OH) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 603-608. refs (Contract NIH-HL-33712)

The neuromuscular and mechanical responses of healthy humans to resistive loading were determined in healthy humans during wakefulness and sleep. Ventilation variables, the changes in the chest wall and upper-airway inspiratory muscle electromyograms (EMGs), and the upper-airway resistance were measured for two breaths immediately preceding and immediately following six applications of an inspiratory resistive load of 15 cm/l s H2O during wakefulness and stage-two sleep. During wakefulness, there was an enhanced chest-wall inspiratory muscle activity in response to loading, but it was accompanied by a proportional increase in inspiratory time, so that rate of rise did not significantly increase. These responses were absent during sleep. Significant upper-airway inspiratory muscle activation with inspiratory resistive loading was not found during wakefulness or sleep.

#### A87-52219

#### HYPOXIA AND MONOSYNAPTIC REFLEXES IN HUMANS

J. C. WILLER, G. MISEROCCHI, and H. GAUTIER (Paris V, Universite, France; Milano, Universita, Milan, Italy) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 639-645. refs

The effect of hypoxia on the monosynaptic reflexes in humans was investigated by studying the recruitment curves of the Hoffman (H) reflex and the direct motor (M) response as a function of stimulus intensity, in both normoxic and hypoxic conditions at sea level. Electromyographic sygnals were derived from surface electrodes placed over the soleus muscle. Exposure to hypoxia did not affect the maximal M response but decreased maximal H

response by 7 percent; there was a decrease of 6 percent in the threshold of both the H and M responses with no change in slope of the recruitment curves. At a constant stimulus eliciting a half-maximal H response, hypoxia caused a 50-percent increase in the amplitude of the H response within 12 min. The results suggest that the effects of hypoxia on the nervous system consist of a direct depolarizing action on the peripheral alpha-fibers and the 1A sensory fibers and of a central effect on supraspinal structures affecting the spinal alpha-motoneurons.

**A87-52221\*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

## HYSTERESIS IN RESPONSE TO DESCENDING AND ASCENDING LOWER-BODY NEGATIVE PRESSURE

CLARE MARIE TOMASELLI, MARY ANNE BASSETT FREY, RICHARD A. KENNEY, and G. WYCKLIFFE HOFFLER (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL; George Washington University, Washing Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Aug. 1987, p. 719-725. refs

Changes in the indices of fluid redistribution and cardiovascular responses during graduated orthostatic stress were measured in 12 men subjected for 25 min to lower-body negative pressure (LBNP) test protocol that involved stepwise decreases (from the starting pressure of -8 to the final -50 mm Hg), followed by stepwise increases (back to -8 mm Hg) of LBNP. The values of many variables measured during the descending phase of LBNP were significantly different from the respective values measured during the ascending phase. These differences appear to be caused by a component of fluid translocation that occurs during LBNP and cannot be reversed within the duration of the procedure. It is hypothesized that this slowly-reversed component is the sequestration of fluid in the interstitial and the lymphatic compartments.

#### A87-52994

#### THE EFFECT OF MICROGRAVITY ON PLASMA-OSTEOCALCIN

C. VERMEER and M. M. W. ULRICH (Limburg, Rijksuniversiteit, Netherlands) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1987, p. 139-142. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart and the Praeventiefonds. refs

Investigations are described which explore whether the bone loss in astronauts as well as in osteoporotic patients may be related to abnormalities in a recently discovered calcium-binding protein, named osteocalcin. It was observed that in all subjects of a limited number of osteoporotic patients, the amount of calcium-binding groups (Gla-residues) in the circulating osteocalcin was substantially reduced. The Gla-content could be normalized, however, by the oral administration of vitamin K (1 mg/day). The Gla-content of plasma-osteocalcin from four astronauts before and after the D-1 mission was also analyzed. The amount of Gla-residues was reduced by more than 50 percent in the post-flight samples. It seems probable that an increased vitamin K-intake by the astronauts will correct the observed abnormality, but whether this will lead to a decrease of the microgravity-induced bone-loss remains to be seen.

#### A87-52998

# EFFECTS OF RECTILINEAR ACCELERATION, CALORIC AND OPTOKINETIC STIMULATION OF HUMAN SUBJECTS IN THE SPACELAB D-1 MISSION

J. WETZIG and R. VON BAUMGARTEN (Mainz, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 161-170. refs

Vestibular experiments performed during the German Spacelab D-1 mission (October 30-November 6, 1985) are described. Related

hardware included the Space Sled and the vestibular helmet, the latter being used for air-colorization of the ears, optokinetic stimulation pattern presentation, and optical and nystagmographic recording of eye movements. It was found that the threshold for the perception of the linear acceleration direction was only slightly lowered while the gain of ocular counterrotation was significantly lowered after the mission as compared to preflight measurements. Optokinetic and caloric nystagmus were enhanced with free-floating.

#### A87-52999

SUBJECTIVE VERTICAL BEFORE AND AFTER SPACE FLIGHT J. R. KASS and H. VOGEL (Mainz, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 171-174. BMFT-supported research

Three astronauts of the D1 Spacelab mission were involved in orientation experiments performed before and after exposure to orbital weightlessness. An attempt was made to determine whether the signals from the otoliths to the CNS are effectively inhibited or enhanced as a result of exposure to O g. Each subject was tilted about a roll axis at 15-deg intervals up to +/- 90 deg and, at each angle, the subject set a luminous line to what he perceived to be vertical. The error in setting the vertical for the high-tilt range was greater during the early postflight period. K.K.

#### A87-53015

## SYSTEMS INTERRELATIONS OF GRAVITY RESPONSES IN THE HUMAN ORGANISM, AND THE USE OF MODELLING

H. HINGHOFER-SZALKAY (Graz, Universitaet, Austria) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 315-321. refs

The application of mathematical modeling techiques to biological systems is considered with emphasis on the question of systems interrelations in the adaptation to weightlessness. Particular attention is given to the regulation of cardiovascular volumes and pressures, the influence of space flight on interstitial and vascular emptying, and the removal of forces to which the musculoskeletal system is subjected.

#### A87-53016

THE MUSCULO-SKELETAL SYSTEM IN MAN - DEVELOPMENT STRUCTURE AND FUNCTION IN DEPENDENCE ON GRAVITY, AND POTENTIAL LIMITATIONS FOR LONG TERM SPACE FLIGHTS

B. KUMMER (Koeln, Universitaet, Cologne, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 323-330. refs

#### A87-53090

## MEDICAL PROBLEMS ASSOCIATED WITH LONG-DURATION SPACE FLIGHTS

WILLIAM M. DECAMPLI (Stanford University, Medical Center, CA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986. San Diego, CA, Univelt, Inc., 1987, p. 197-220. (AAS PAPER 86-115)

Potential medical problems related to a 3-year duration mission to Mars are discussed. The microgravity effects of cardiovascular and muscular deconditioning, bone resorption, and sensorimotor maladaptation are examined. The effects of hostile external (radiation) and internal (infectious disease, psychological isolation and confinement, trauma, and airborne toxins) environments on the crew are studied. Consideration is given to endogenous medical problems (such as gastrointestinal and respiratory diseases and cancer) not detectable prior to the mission and to potential surgical emergencies.

#### A87-53620

EXECUTION OF 'ARC' EXPERIMENT ON SPACE SHUTTLE 'DISCOVERY' STS 51-C - SOME RESULTS ON AGGREGATION OF RED BLOOD CELLS UNDER ZERO GRAVITY

L. DINTENFASS (Sydney, University, Australia) Biorheology (ISSN 0006-355X), vol. 23, no. 4, 1986, p. 331-347. Research supported by the Australian Department of Science and Technology, Philip Bushell Foundations, CIBA-GEIGY AG, CSIRO, and USRA. refs

Data from an experiment conducted on the Space Shuttle from January 24-25, 1985 to define the kinetics and morphology of aggregation of red blood cells under zero gravity and under normal gravity are presented. Blood samples from healthy donors and donors with a history of ischaemic heart disease, colon cancer, juvenile-onset diabetes, and hyperlipidaemia were processed using an automated slit-capillary photoviscometer. The design and operation of the photoviscometer, which is composed of an optical, blood metering, and thermal electronic subsystems, is described. Analysis of micro- and macrophotographs of the red blood cell samples reveal that the red blood cells do not change shape under zero gravity; however, aggregation does occur. In the pathologic blood, it is observed that the aggregates show a morphology of normal rouleaux under zero gravity; however, on the ground, clumps of red cells are detected. It is suggested that zero gravity may affect cell-to-cell interaction and the microstructure of the cell membrane.

N87-29080# Joint Publications Research Service, Arlington, Va. JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 21, NO. 2, MARCH - APRIL 1987

O. G. GAZENKO, ed. 15 Jun. 1987 157 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), Mar.-Apr. 1987 407 p (JPRS-USB-87-004) Avail: NTIS HC A08/MF A01

Various topics in space biology and aerospace medicine are discussed. Sociopsychological screening of flight personnel; the effects of alcohol, emotions and stress on performance; hypokinesis; radiation damage; pilot head kinematics during ejection into air flow; and the efficiency of anti-gravity suits with exposure to continuously increasing accelerations are among the topics covered.

# N87-29082# Joint Publications Research Service, Arlington, Va. FORMATION OF SPATIAL POSITION IMAGE WITH ONSET OF ILLUSIONS OF VESTIBULAR ORIGIN

O. A. VOROBYEV and V. V. IVANOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 7-13 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 7-12

Avail: NTIS HC A08/MF A01

Specific features of a pilot's spatial orientation in response to spatial illusions of vestibular origin associated with their recognition and management are discussed. Analysis of data in the literature and observations by the present authors allow the conclusion that the pilot's spatial orientation, once spatial illusions have emerged, makes him assess not only the instrumental information, but also the pattern of his own controlling movements. As a consequence, it is suggested that in relation to the formation of a correct image of spatial position (particularly in the case of spatial illusions), the pilot's controlling movements act as part of instrumental information concerning the spatial position of the flying vehicle.

# N87-29088# Joint Publications Research Service, Arlington, Va. DYNAMICS OF FLUID TURNOVER IN HUMAN EXTREMITIES AS RELATED TO DIFFERENT BODY POSITIONS

N. YE. PANFEROVA and T. A. KABESHEVA In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 57-64 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 40-45

Avail: NTIS HC A08/MF A01

Anthropometric measurements and occlusion venous plethysmography were used to investigate fluid inflow and outflow in the limbs of human subjects who kept normal motor activity for 4 hours, remained in recumbency or were in the head down position at an angle of -12 degrees and -22 degrees (to simulate effects of zero gravity). During these exposures diuresis, heart rate and blood pressure were measured. In the horizontal and, to a greater extent, the head down position, when motor activity was diminished. volume blood flow velocity in the limbs decreased, i.e., blood inflow to them became smaller. Arm volume varied insignificantly since inflow and outflow were in balance, whereas leg volume decreased because fluid outflow was larger than inflow. In the head down position, the tone of the leg veins also declined. The data obtained indicate an active involvement of the peripheral vascular bed in the adaptation to diminished motor activity in the horizontal and head down position of human bodies.

# N87-29089# Joint Publications Research Service, Arlington, Va. FUNCTIONAL STATE OF THE HUMAN CARDIORESPIRATORY SYSTEM FOLLOWING 30-DAY ANTIORTHOSTATIC HYPOKINESIA

G. V. MACHINSKIY, V. P. BUZULINA, V. M. MIKHAYLOV, and E. I. NECHAYEVA In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 65-68 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 46-48

Avail: NTIS HC A08/MF A01

Before and after 30 day head down tilt (-8 degrees), the cardiorespiratory function of six healthy volunteers was assessed using an exercise test (aerobic workload on the treadmill that grew to the maximal level). After hypokinesia the maximal oxygen consumption decreased by 9.9 percent and total oxygen debt by 23 percent. The bioelectric activity of the heart showed a decrease of the T sub A wave by 34 percent and the T sub D by 30 percent. These changes are evidence that the cardiorespiratory system declined and as a consequence the ability of the subjects to perform sustained physical work of an aerobic character also declined.

# N87-29090# Joint Publications Research Service, Arlington, Va. VARIANT OF QUANTITATIVE EVALUATION OF MECHANISMS OF CENTRAL HEMODYNAMIC ORTHOSTATIC REACTIONS

P. A. TITUNIN, M. L. SVESHCHINSKIY, V. F. CHUDIMOV, and S. F. ZEROV In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 69-74 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 48-52 Avail: NTIS HC A08/MF A01

An approach that can help clarify mechanisms of central circulation of orthostatic men using a mathematical model and noninvasive methods of examination is described. Circulation parameters such as peripheral resistance, arterial compliance, and ratio of vein compliance to the pump coefficient of the heart were determined by the partial identification method of the work component circulation model with the aid of cardiac output and arterial blood pressure measured by tetrapolar thoracic rheography and tachooscillography. A physiological interpretation of the above parameters, as related to the upright posture of man, is also

Author

N87-29099# Joint Publications Research Service, Arlington, Va. AUTOMATED ANALYSIS OF VECTORCARDIOGRAMS IN SPACE MEDICINE

N. I. VIKHROV, L. S. SOLOVYEVA, V. D. TURBASOV, V. K. VASILYEV, B. R. S. REDDI, and R. S. CHATTERJEE *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 120-124 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 79-82 Avail: NTIS HC A08/MF A01

An system of automated processing of vectorcardiographic (VCG) data is discussed. The spatial characteristics of the heart's electric field were measured in cosmonauts on the ground, in weightlessness at rest (5 minutes), during exercise (power of 130 W, 5 minutes) on a cycle ergometer, and during the recovery period (5 minutes). On the whole, the changes in VCG parameters under the influence of spaceflight factors were moderate. The parameters reverted to the preflight range within 4 days. Author

# N87-29100# Joint Publications Research Service, Arlington, Va. EFFECT OF VESTIBULAR STIMULATION ON STATIC PHYSICAL WORK CAPACITY

A. A. PODSHIVALOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 125-128 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 83-84

Avail: NTIS HC A08/MF A01

A study of the static physical work capacity (SPW) of cervical extensors revealed that SPW diminishes after stimulation of the vestibular system and development of motion sickness reactions. The reliable decline of SPW of cervical extensors with vestibular stimulation confirms the close connection between propriocepters of cervical muscles and the vestibular system. Passive vestibular conditioning with prolonged, contrived displacement of the head enhances SPW of cervical muscles and prevents its decline following vestibular stimulation.

# N87-29102# Joint Publications Research Service, Arlington, Va. EFFECT OF VOLUNTARY CONTROL OF RESPIRATION ON FUNCTIONAL STATE OF THE CARDIORESPIRATORY SYSTEM IN THE PRESENCE OF HYPOXIC HYPOXIA

YE. P. GORA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 132-134 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskay Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 86-87

Avail: NTIS HC A08/MF A01

At the present time there are no clearcut ideas about the effect of the modification of voluntary breathing on the functional state of the body in the presence of acute hypoxia. The objective was to test the influence of some modes of voluntary respiration on the cardiorespiratory system function in the presence of different degrees of acute hypoxia.

## N87-29104# Joint Publications Research Service, Arlington, Va. EVALUATION OF PSYCHOLOGICAL FITNESS FOR FLIGHT WORK

V. I. YEVDOKIMOV In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 139-144 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, Mar. - Apr. 1987 p 89-92 Avail: NTIS HC A08/MF A01

In order to assess the the qualitative and quantitative aspects of psychological fitness for flying, a flight variant of the Thematic Apperception Test (TAT) was used. The flight variant of the TAT consisted of microsocial topics (intimate, family relations) and pictures on aviation subjects. It was concluded that by using the flight variant of the TAT one can detect psychological traits that

are important to successful performance of flight assignments, which cannot be assessed by other methods in a number of cases.

Author

N87-29105# Joint Publications Research Service, Arlington, Va. SYMPOSIUM ON SPACE GASTROENTEROLOGY

K. V. SMIRNOV In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 145-147 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 93-94

Avail: NTIS HC A08/MF A01

Eight papers on the topic of space gastroenterology are briefly discussed. The phenomenology of changes in the digestive system; adaptive changes in hydrolysis, transport and utilization of carbohydrates in hypogravity and hypokinetic conditions; the role of digestive organs in lipid metabolism under hypokinetic conditions; intestinal microecology during spaceflight; human bile and pancreatic secretions in the presence of emotional stress caused by taking state tests or first parachute jumps; the effect of hypokinesia on parameters of liver function; and changes in the fatty acid composition of human blood serum during 120 day hypokinesia are among the topics discussed.

N87-29108# Defence Research Information Centre, Orpington (England).

## TREATMENT OF DEGENERATIVE DISEASES OF THE SPINE BY PHYSIOTHERAPY

W. KOCH and A. LYNN Dec. 1985 11 p Transl. into ENGLISH from Orthop. Praxis (West Germany), no. 9, 1982 p 690-695 (DRIC-T-7613) Avail: NTIS HC A02/MF A01

Three methods of treating degenerative diseases of the spine by physiotherapy are reviewed. Specific examples involving patients are discussed which demonstrate the effectiveness of different heat, physiotherapy, and exercise treatments. The uses of physiotherapy for differing degrees of disorders and backache are also considered, from its use in post-operative therapy to simple self-help ergotherapy exercise treatments.

N87-29109# Universal Energy Systems, Inc., Dayton, Ohio.
OPTIMIZATION OF PERIPHERAL VISION Final Report, Apr. Sep. 1985

JULIEN M. CHRISTENSEN, ROBERT D. ODONNELL, CLARK A. SHINGLEDECKER, CONRAD L. KRAFT, and GARY WILLIAMSON Nov. 1986 82 p
(Contract F33615-84-D-0658)

(AD-A182438; USAFSAM-TR-85-96) Avail: NTIS HC A05/MF A01 CSCL 06D

One of the most exciting ideas that has emerged fairly recently in the time-honored area of visual research is that of a system that consists of the central (also foveal or focal) and the peripheral (also ambient) subsystems. The subsystems functions are roughly described as what and where. Such broad assignment of function is acceptable as long as we don't forget that some of each function (i.e., location and identification) is subserved by both subsystems and that there is significant interaction between the two. In the past, the overwhelming amount of scientific attention has been toward the central subsystem; relatively speaking, the peripheral subsystem has been seriously neglected. This report should stimulate renewed interest within the U.S. Air Force in discovering more about the capabilities and limitations, both inherited and acquired, of the peripheral subsystem. The reports include sections on anatomical foundations; functional performance characteristics; improvement through training; history of peripheral vision displays; and experimental occlusion techniques.

N87-29110# Yale Univ., New Haven, Conn. Dept. of Psychology.

LÉVELS ŐF ANALYSIS OF COMPLEX AUDITORY STIMULI Final Report, 1 Sep. 1984 - 31 Aug. 1986

ARTHUR G. SAMUEL 16 Jan. 1987 50 p

(Contract AF-AFOSR-0324-84)

(AD-A182699; AFOSR-87-0861TR) Avail: NTIS HC A03/MF A01 CSCL 06D

The two-year project (AFOSR 84-0324) called for work in several areas of complex auditory pattern perception. Our first annual report summarized research in two of these areas. This report summarizes our efforts in four other areas. The most detailed section of this report covers work on the perception of normal and whispered speech. Using the selective adaptation paradigm, this study examined the representation of stops and continuants. The results supported the existence of a simple acoustic, peripheral level of representation, and a complex acoustic, central level of representation. Three other lines of research are briefly summarized in this report. First, several experiments tested the putative role of the syllable in the disruption of perception under conditions of signal ear-alternation. The second brief report covers work on timbre perception. A trumpet - cello continuum of tokens was synthesized, and used in various speech perception paradigms. The final brief summary reports work on the perceptual restoration of musical notes. Those experiments were designed to explore possible commonalities in the use of expectations in the perception of complex auditory patterns. The data suggest that music perception does make use of expectations, and that aspects of such perception are analogous to the use of lexical and sentential information in speech.

N87-29111# Systems Science and Software, La Jolla, Calif. CHARGING OF A MAN IN THE WAKE OF THE SHUTTLE G. A. JONGEWARD, I. KATZ, M. J. MANDELL, and J. R. LILLEY, JR. Jul. 1986 69 p (Contract F19628-82-C-0081)

(AD-A182789; SSS-R-86-8064; AFGL-TR-86-0139; SR-5) Avail: NTIS HC A04/MF A01 CSCL 20C

Charging of the DMSP F6 and F7 satellites is shown to result from the combined effects of high flux of high energy auroral electrons and low ambient background ion density. POLAR computer code calculations are presented which show that a shuttle size object will charge more than 3000 volts negative under these charging conditions. The highly charged shuttle accelerates ions to the shuttle potential producing a high energy mono-energetic plasma environment near the shuttle. During these charging events, an astronaut performing EVA will charge with its ion collection orbit limited. Material secondary properties will produce differential charging on the astronaut of the same magnitude as the shuttle charging potential. NASCAP computer code calculations of EMU charging in the near shuttle environment show differential voltage of 2600 volts and overall charging 1000 volts more negative than the shuttle will occur.

N87-29112# National Aerospace Medical Centre, Soesterberg (Netherlands).

ACTIVITIES REPORT IN AEROSPACE MEDICINE Annual Report, 1985 [STICHTING NATIONAAL LUCHT-ENRUIMTE-VAARTGENEESKUNDIG CENTRUM]

1985 42 p in DUTCH

(ETN-87-90153) Avail: NTIS HC A03/MF A01

Research in X-ray recording, electroencephalograms, military activities, airline operations, certificates, and ophthalmology are described.

N87-29113 California Univ., Los Angeles.
CAROTID BODY CONTRIBUTIONS TO THE EXERCISE HYPERNEA IN MAN Ph.D. Thesis

JOHN WILLIAM MACDONALD, II 1987 212 p

Avail: Univ. Microfilms Order No. DA8711689

Evidence suggests that the carotid bodies contribute to hypernea during steady-state exercise. There is little systematic investigation of how work-rate influences their proportional

contribution. The purpose of this investigation was to explore this issue, by application of the Dejours' O2-switching technique, in healthy subjects at moderate and heavy work-rates. Based upon the assumption that 100 percent O2 silences the carotid body chemoreflex, Dejours devised a scheme to estimate the magnitude of the carotid body drive. Hence, switching a subject's inspirate from air to O2 caused ventilation (VE) to fall after 2 to 3 breaths reflecting the vascular transit delay from the lungs to carotid bodies; the VE decay is assumed to represent the effect of turning off the carotid bodies. Recognizing that secondary factors might influence VE prior to the carotid chemoreflex being completely suppressed, a technique was developed for predicting the full magnitude of this suppression. This technique was based on evidence which shows that the carotid chemoreceptor and ventilatory response dynamics to primary changes in alveolar and arterial PO2 appear to be first-order. It is suggested that the proportional contribution of the carotid bodies to the hypernea of steady-state exercise is independent of work-rate. The predicted data led to the same conclusion as the observed data with a proportional VE fall of 26.9 percent. Dissert, Abstr.

**N87-29114\***# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EMPIRICAL MODELS FOR USE IN DESIGNING DECOMPRESSION PROCEDURES FOR SPACE OPERATIONS JOHNNY CONKIN, BENJAMIN F. EDWARDS (Krug International, Houston, Tex.), JAMES M. WALIGORA, and DAVID J. HORRIGAN, JR. Jun. 1987 52 p

(NASA-TM-100456; S-562; NAS 1.15:100456) Avail: NTIS HC A04/MF A01 CSCL 06P

Empirical models for predicting the incidence of Type 1 altitude decompression sickness (DCS) and venous gas emboli (VGE) during space extravehicular activity (EVA), and for use in designing safe denitrogenation decompression procedures are developed. The models are parameterized using DCS and VGE incidence data from NASA and USAF manned altitude chamber decompression tests using 607 male and female subject tests. These models, and procedures for their use, consist of: (1) an exponential relaxation model and procedure for computing tissue nitrogen partial pressure resulting from a specified prebreathing and stepped decompression sequence; (2) a formula for calculating Tissue Ratio (TR), a tissue decompression stress index; (3) linear and Hill equation models for predicting the total incidence of VGE and DCS attendant with a particular TR; (4) graphs of cumulative DCS and VGE incidence (risk) versus EVA exposure time at any specified TR; and (5) two equations for calculating the average delay period for the initial detection of VGE or indication of Type 1 DCS in a group after a specific denitrogenation decompression procedure. Several examples of realistic EVA preparations are provided.

**N87-30025\***# Brown Univ., Providence, R. I. Dept. of Lab. Medicine.

GROWTH FACTOR INVOLVEMENT IN TENSION-INDUCED SKELETAL MUSCLE GROWTH Semiannual Status Report, 1 Apr. - 31 Sep. 1987

H. H. VANDENBURGH 1987 8 p

(Contract NAG2-414)

(NASA-CR-181349; NAS 1.26:181349) Avail: NTIS HC A02/MF A01 CSCL 06P

Muscle tissue culture techniques were developed to grow skeletal myofibers which differentiate into more adult-like myofibers. Mechanical simulation studies of these muscle cells in a newly developed mechanical cell simulator can now be performed to study growth processes in skeletal muscle. Conditions in the mechanical cell simulator were defined where mechanical activity can either prevent muscle wasting or stimulate muscle growth. The role of endogenous and exogenous growth factors in tension-induced muscle growth is being investigated under the defined conditions of tissue culture.

N87-30026# School of Aerospace Medicine, Brooks AFB, Tex. Radiation Physics Branch.

PROCEEDINGS OF A WORKSHOP ON RADIOFREQUENCY **RADIATION BIOEFFECTS Final Report** 

JOHN C. MITCHELL, ed. Apr. 1985 242 p Workshop held in Wachtberg-Werthhoven, West Germany, 11-13 Sep. 1984; sponsored by NATO

(Contract AF PROJ. 7757)

(AD-A157090; USAFSAM-TP-85-14) Avail: NTIS HC A11/MF A01 CSCL 06R

The workshop addressed new developments in the field of Radio Frequency Radiation (RFR). Safety standards, assessment of RFR levels in the military environment, RFR instrumentation and dosimetry, biological effects of long-term low-level RFR exposures and pulsed versus continuous wave effects are among the topics discussed.

N87-30027# Utah Univ., Salt Lake City. Dept. of Electrical Engineering.

#### PHYSICAL INTERACTIONS OF RADIOFREQUENCY RADIATION FIELDS AND BIOLOGICAL SYSTEMS

In SAM, Proceedings of a Workshop on CARL H. DURNEY Radiofrequency Radiation Bioeffects p 5-36 Apr. 1985 Previously announced as N85-27129

Avail: NTIS HC A11/MF A01 CSCL 06R

A biological system irradiated by radiofrequency radiation (RFR) responds to the internal RFR fields produced by that irradiation. The measurement and calculation of the internal fields is called dosimetry. The internal fields are often described in terms of the specific absorption rate (SAR) in watts/kilogram. A combination of techniques, each valid for a particular model and in a particular frequency range, are used to calculate average whole body SAR's for models of human beings and other animals over a wide frequency range for plane wave irradiation. Calculating SAR's for near field irradiation is much more difficult than for plane wave irradiation; thus, fewer near field SAR data are available. To calculate spatial distribution of SAR's is still more difficult (especially at higher frequencies); this problem in dosimetry is yet to be solved satisfactorily, although significant progress has recently been made in this area.

#### N87-30028# Yale Univ., New Haven, Conn. THERMAL PHYSIOLOGY OF RFR INTERACTIONS IN ANIMALS AND HUMANS

ELEANOR R. ADAIR In SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 37-54 Avail: NTIS HC A11/MF A01 CSCL 06R

The description of thermoregulation in any endotherm involves detailed knowledge of thermoregulatory behavior, both instinctive and learned, as well as knowledge of autonomic processes of heat production and heat loss. It is shown that the particular autonomic response that may be ongoing at any given time is dictated by the prevailing environmental temperature. In other words, endotherms shiver in the cold and pant or sweat in the heat, but not the reverse, and they will avoid doing either if an efficient behavioral maneuver is available to them. Radiofrequency radiation (RFR) may be regarded as part of the thermal environment to which man and other endotherms may be exposed. The maintenance of heat balance in a body exposed to radiofrequency radiation is discussed.

#### N87-30029# School of Aerospace Medicine, Brooks AFB, Tex. CRITICAL REVIEW OF SELECTED TOPICS ON BIOLOGICAL **EFFECTS OF RADIOFREQUENCY RADIATION**

JEROME H. KRUPP, LOUIS N. HEYNICK, and PETER POLSON (SRI International Corp., Menlo Park, Calif.) In its Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 55-84 Apr. 1985

Avail: NTIS HC A11/MF A01 CSCL 06R

Several selected reports regarding radio frequency radiation (RFR) bioeffects that were considered important with regard to possible hazards to human beings were critically reviewed. Researchers concluded that no reliable evidence indicates that chronic exposure to RFR at incident average power densities below 1 mW/square cm or at SAR's below 0.4 W/kg are hazardous to human health. Important uncertainties are reviewed.

#### N87-30030# School of Aerospace Medicine, Brooks AFB, Tex. RADIOFREQUENCY RADIATION SAFETY STANDARDS

JOHN C. MITCHELL In its Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 85-102 Previously announced as N85-27137

Avail: NTIS HC A11/MF A01 CSCL 06R
Using a safety factor of 10, the American Standards Institute developed radio frequency radiation (RFR) protection guides that will limit all human whole body exposures to incident energy that results in a specific absorption rate (SAR) no greater than 0.4 W/kg. This allows incident average power densities from 1 to 100 mW/square cm depending upon the frequency of the radiation. New safety guidelines are compared with many other RFR standards used throughout the world.

#### N87-30031# Office of Naval Research, Arlington, Va. RFR RESEARCH PROJECTIONS FOR THE FUTURE

MICHAEL T. MARRON In SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 103-119 Apr. 1985 Avail: NTIS HC A11/MF A01 CSCL 06R

A review is given of where we are going in the field of bioelectromagnetics. It is concluded that research into the mechanisms by which electromagnetic fields interact with biological tissue will assume increasing importance ir the next few years. The major new impetus for mechanism research will be derived from beneficial applications of electromagnetic fields to biological tissue. Use of electric and magnetic fields to promote healing is already widespread and will continue to increase.

### N87-30032# School of Aerospace Medicine, Brooks AFB, Tex. THE CUMULATIVE EFFECTS OF LONG-TERM EXPOSURE TO LOW LEVELS OF RADIOFREQUENCY RADIATION (RFR)

JEROME H. KRUPP In its Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 121-133 Apr. 1985 Previously announced as N85-27132

Avail: NTÍS HC A11/MF A01 CSCL 06R

Over a four-year period of planning, pilot study, and definitive experiment, a lifetime exposure is given to a population of test animals (100) whose state of health, growth, and cause of death are closely monitored. An equal number of sham expected animals served as a comparison population. After 25 months of exposure, at the point where there is 90 percent mortality in both groups, the remaining subjects are sacrificed and assayed. The overall conclusion is that no cumulative ill effects could be attributed to the life-long exposure at absorption rates of 0.4 W/kg or less.

#### N87-30033# School of Aerospace Medicine, Brooks AFB, Tex. HUMAN EXPOSURES TO RADIOFREQUENCY RADIATION (RFR). A REVIEW OF RFR ACCIDENTS

JOHN C. MITCHELL In its Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 135-141 Avail: NTIS HC A11/MF A01 CSCL 06R

A review and analysis of Air Force radio frequency radiation (RFR) accident files were performed. The following conclusions are evident: (1) of the 296 suspected overexposures, only 58 (approx. 20 percent) were confirmed, the other 80 percent being within the permissible exposure limit; (2) about half of the overexposures were detected because the individual(s) felt a warming sensation; (3) essentially all of the exposures were partial body exposures; (4) actual exposure times were most often less than 6 minutes; and (5) most of these exposures occurred at frequencies between 1 and 10 GHz. Medical review of the physical examinations following RFR overexposure revealed few consistent clinical patterns. Erythema and/or edema were rare findings at the time of the examination. Lenticular findings such as vacuoles and opacities were noted in some overexposed individuals receiving radiation to the head. None of these findings, however, were

deemed clinically significant since there was no concomitant visual impairment.

Author

N87-30034# Defence Research Establishment, Ottawa. (Ontario).

## APPLICATION OF HUMAN WHOLE-BODY RF ABSORPTION MEASUREMENTS TO RFR SAFETY STANDARDS

DOUGLAS A. HILL /n SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 143-161 Apr. 1985

Avail: NTIS HC A11/MF A01 CSCL 06R

Human whole-body radiofrequency (RF) absorption rates were measured as a function of body orientation, wave impedance, separation from ground, and frequency (from 3 to 40 MHz). Results applicable to RF radiation protection are summarized. The worst-case radiation exposure situation is taken to be the far-field whole-body exposure of a man wearing footgear and standing on the ground plane. Assuming that 0.4 W/kg is a safe whole-body specific absorption rate (SAR), the permitted exposure levels (PEL's) set by the 1982 ANSI standard are well supported by researchers' results. On the other hand, PEL's set by NATO STANAG 2345 are unsafe at most frequencies from 5 to 40 MHz. RF currents through the feet of grounded subjects were also measured. For the maximum exposures permitted by the ANSI standard, the RF currents cause a localized SAR in the ankle region of 16 W/kg. Author

**N87-30035**# Laboratory for Electronic Development of the Armed Forces, Oegstgeest (Netherlands).

## EXPOSURE TO RADIOFREQUENCY FIELDS IN THE NETHERLANDS: MEASUREMENTS AND EVALUATION

AUGUSTINUS B. WOLTERING In SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 163-177 Apr. 1985

Avail: NTIS HC A11/MF A01 CSCL 06R

The activities carried out on behalf of the inventory of the power flux density (PFD) in the vicinity of civil radio frequency (RF) sources in the frequency band of 0.5 MHz to 18 GHz are discussed. A computer program that gives a general (theoretical) impression of the RF environment was developed. Information about civil transmitters was collected and relevant technical parameters to be used as input data for this computer program were deduced. Measurements in the vicinity of RF emitting equipment such as seal machines that are too complex to model theoretically were carried out.

# N87-30036# London Univ. (England). Dept. of Physics. DIELECTRIC BEHAVIOUR OF WATER IN BIOLOGICAL MATERIAL WITH PARTICULAR REFERENCE TO BRAIN TISSUE

EDWARD H. GRANT /n SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 179-186 Apr. 1985

Avail: NTIS HC A11/MF A01 CSCL 06R

The absorption of microwave energy by biological material at frequencies in excess of 1 GHz is due mainly to the water content. Knowledge of the dielectric properties of water in biological material is therefore a necessary prerequisite for the calculation of energy deposition. However, the water of hydration immediately adjacent to biological macromolecules is subject to chemical forces different from those in bulk water and must in consequence exhibit different dielectric properties. The nature and proportion of this water vary considerably from one tissue to another and therefore need to be evaluated for each specific case. For adult rabbit brain material, dielectric measurements show that the water of hydration constitutes about 20 percent of the total while the remainer has dielectric properties similar to those of pure water. With brain tissue from recently born rabbits, the proportion of water of hydration is indistinguishable from zero. Author

N87-30037# Bundesgesundheitsamt, Neuherberg (West Germany). Inst. for Radiation Hygiene.

## EVALUATION OF HUMAN EXPOSURE TO LOW FREQUENCY FIELDS

JURGEN H. BERNHARDT In SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 187-202 Apr. 1985 Previously announced as N85-27135

Avail: NTIS HC A11/MF A01 CSCL 06R

Threshold values of field strength or current density, inducing biological effects are compiled from experimental and theoretical studies. On the basis of these data it is possible to establish safe, dangerous and hazardous current density curves as a function of frequency. The criterion for the definition of injury is the elicitation of ventricular fibrillation which must be avoided. To define exposure limits, the field strength or current density causing injury should be reduced by a factor exceeding 100. The arguments supporting this wide safety margin are discussed. The electric and magnetic field strength in the human environment is correlated with the corresponding electric current density induced in the human body. This enables safe, dangerous and hazardous levels of current density in the human body to be correlated with the external electric or magnetic field strength.

N87-30038# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

## RADIOFREQUENCY RADIÁTION SAFETY GUIDELINES IN THE FEDERAL REPUBLIC OF GERMANY

KLAUS W. HOFMANN In SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 203-216 Apr. 1985

Avail: NTIS HC A11/MF A01 CSCL 06R

The German safety rules in the fields of electronics and electricity are summarized. Part 1 of the standard includes instructions on how to take measurements and how to do calculations so as to get comparable results. Part 2 is concerned mainly with direct effects of electric shock. Part 3, which exists only in draft form, includes guidelines for the protection against explosive gas-air mixtures. Part 4, which is still under consideration, deals with electroexplosive devices.

**N87-30039**# Defence Research Establishment, Ottawa. (Ontario).

## RADIOFREQUENCY RADIATION SAFETY OF TWO MANPACK TRANSCEIVERS (AN/PRC-515 AND AN/PRC-77)

DOUGLAS A. HILL In SAM, Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 217-223 Apr. 1985

Avail: NTIS HC A11/MF A01 CSCL 06R

The radiofrequency radiation (RFR) safety of two Canadian Forces manpack transceivers (AN/PRC-515 and AN/PRC-77) was studied by a university contractor. The relationship of his study to current thinking in the field of RFR safety is explained. The main findings are summarized and applied to operations. It is concluded that both transceivers are safe under all practical operating conditions.

Author

N87-30040# Ottawa Univ. (Ontario). Dept. of Electrical Engineering.

# SPÉCIFIC ABSORPTION RATE DISTRIBUTIONS IN A HETEROGENEOUS MODEL OF THE HUMAN BODY AT RADIOFREQUENCIES

S. S. STUCHLY Jun. 1987 102 p

(Contract EPA-R-812156)

(PB87-201356; EPA/600/1-87/003) Avail: NTIS HC A06/MF

A01 CSCL 06R

The electric field distribution of the rate of energy absorption referred to as the specific absorption rate (SAR) in a biological body is a complex function of several exposure parameters such as frequency, intensity of the incident field, polarization, source to object configuration (near field vs far field), and the body characteristics such as size, shape, and dielectric properties. An experimental approach was employed to determine SAR patterns in a full scale heterogeneous model of man exposed to radiofrequency fields at 160, 350, and 914 MHz in the far and near fields for two polarizations. The model had an anatomically

correct shape and contained a skull, spinal cord, rib cage, and all major bones (except those in the feet and hands), brains, lungs, and muscle tissue. The square of the electric field inside the model was measured by a small diameter electric field probe. Data acquisition, exposure conditions, and data processing were under computer control. Specific circuitry including an optical link was used to interface the electric field probe with the computer. Extensive data were obtained, analyzed, and compared with the data for a homogeneous model.

N87-30041\* National Aeronautics and Space Administration, Washington, D.C.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING **BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 302)** 

Oct. 1987 55 p

(NASA-SP-7011(302); NAS 1.21:7011(302)) Avail; HC A04

**CSCL 06E** 

This bibliography lists 131 reports, articles, and other documents introduced into the NASA scientific and technical information system in September, 1987.

N87-30042# Joint Publications Research Service, Arlington, Va. USSR REPORT: LIFE SCIENCES. BIOMEDICAL **BEHAVIORAL SCIENCES** 

29 Apr. 1987 93 p Transl. into ENGLISH from various Russian articles

(JPRS-UBB-87-009) Avail: NTIS HC A05/MF A01

Topics addressed include: aerospace medicine, agrotechnology; biochemistry; biophysics; immunology; pharmacology toxicology; physiology; public health; radiation biology; nonionizing electromagnetic radiation; military medicine; laser bioeffects; epidemiology; and genetics.

N87-30043# Joint Publications Research Service, Arlington, Va. CIRCULATORY CHANGES IN CAROTID ARTERY BASIN IN RESPONSE TO ANTIORTHOSTASIS AND ANTIORTHOSTATIC **BED REST Abstract Only** 

B. M. FEDOROV, YE. N. STRELTSOVA, and T. V. SEBEKINA In its USSR Report: Life Sciences. Biomedical and Behavioral 29 Apr. 1987 Transl. into ENGLISH from Sciences p 1 Fiziologiya Cheloveka (Moscow, USSR), v. 11, no. 5, Sep. - Oct. 1985 p 755-762 Original language document was announced in IAA as A86-15513

Avail: NTIS HC A05/MF A01

The effect of antiorthostasis (AO) on circulation in the carotid pool was studied in healthy men placed in -8 deg head-down tilt, and in anesthesized dogs subjected to -45 or -90 deg AO. The 5-day-long antiorthostatic hypokinesia in men led to a decreased blood flow in the carotid and orbital arteries, an increase in the peripheral resistance index, a decreased reactivity to the compression test, and a decreased functioning of the flow along the anterior communicating artery when the common carotid was compressed. During the later phases of the 30-day long AO, these blood flow indices tended to return to normal. In dogs, the AO led to a sharp increase in pressure in the jugular veins and in peripherals of the carotid pool, and to a decrease of blood flow rate in the carotid arteries.

N87-30044# Joint Publications Research Service, Arlington, Va. HEMODYNAMIC EFFECTS OF NEGATIVE PRESSURE IN **LOWER BODY Abstract Only** 

M. M. MIRRAKHIMOV, T. A. AZHIMAMATOV, and T. B. BALTABAYEV *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 2 29 Apr. 1987 ENGLISH from Fiziologiya Cheloveka (Moscow, USSR), v. 11, no. 5, Sep. - Oct. 1985 p 763-769 Original language document was announced in IAA asA86-15514

Avail: NTIS HC A05/MF A01

The effect of lower body negative pressure (LBNP) on the cardiovascular functions was studied in 42 normal male subjects aged 31-64 yrs, using noninvasive methods of electrocardiography. phonocardiography, and tetrapolar thoracic rheography. The responses to the LBNP included increases in heart rate and in

systemic vascular pressure, decreases in the heart rate and the cardiac indices as well as in the volumes of the cardiac chambers, caused by partial detainment of blood in the large-capacity blood vessels of the lower body. The degree of these changes depended on the magnitude of applied LBNP, which was in the range of 20-60 mm. Rapid (2-3 sec) decompression caused the temporarily detained blood to enter the circulation, leading to short-term increases of the cardiac volume load and to reversal of the hemodynamic effects caused by the LBNP.

N87-30045# Joint Publications Research Service, Arlington, Va. INTERACTION OF MACULA AND SEMICIRCULAR CANALS IN ANGULAR STABILIZATION OF MAN IN SPACE Abstract Only V. M. GUSEV and V. A. KISLYAKOV In its USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 2-3 1987 Transl. into ENGLISH from Biofizika (Moscow, USSR), v. 31, no. 1, Jan. - Feb. 1986 p 123-127 Original language document was announced in IAA as A86-27474 Avail: NTIS HC A05/MF A01

A mathematical model is developed for spatial angular stabilization in which the fixed and variable space coordinates are related to the coordinates of the semicircular canals and the otolithic organ during spatial displacement. The equations describing the interrelationship of both vestibular systems are solved for the case of abrupt displacement of angular vectors, and for the case of slow periodic variations of the same angles, approximating the pitching and rocking motion of a medium-size fishing trawler. The results indicate a need for integrated activity of both the semicircular canals and the otolithic organ for an acceptable stabilization: the canals insure short-term stabilization and stabilization during the abrupt changes of spatial orientation, while the otolithic organ plays a dominant role during long-term slowly occurring changes.

N87-30046# Ministry of Defence, Tel-Aviv (Israel). Directorate of Defence R and D.

ADJUSTMENT AND VALIDATION OF THE MATHEMATICAL PREDICTION MODEL FOR SWEAT RATE, HEART RATE AND BODY TEMPERATURE UNDER OUTDOOR CONDITIONS Annual Report, 7 Oct. 1985 - 6 Oct. 1986

Y. SHAPIRO, R. BURSTEIN, and Y. EPSTEIN 1 Nov. 1986

(Contract DAMD17-85-G-5044)

(AD-A183109) Avail: NTIS HC A02/MF A01 CSCL 06J
This study is conducted in order to validate under outdoor conditions, and if necessary, to adjust the mathematical models to predict physiological tolerance under different environmental conditions, solar loads, clothing ensembles, and metabolic rates. Different physiological parameters were carefully monitored. The results show that the prediction models, which were developed from laboratory studies, are conservative and overestimate the physiological responses under outdoor conditions. It is hypothesized that a factor related to long wave radiations should be included in the equations.

N87-30047# School of Aerospace Medicine, Brooks AFB, Tex. SPATIAL ORIENTATION IN FLIGHT Final Report, Jan. 1982 -Jan. 1985

KENT K. GILLINGHAM and JAMES W. WOLFE Dec. 1986 133

(AD-A183431; USAFSAM-TR-85-31) Avail: NTIS HC A07/MF A01 CSCL 06J

Man's orientational mechanisms, and how those mechanisms fail in flight, are discussed in this comprehensive review. Specific include: Mechanics and associated nomenclature; visual orientation; vestibular function and information processing; other senses of motion and position; spatial disorientation, including causes, types, examples, statistics, and methods of preventing orientation mishaps; and the significance, etiology, and therapy of motion sickness. Forty-three figures are included, many illustrating vestibular anatomy and physiology, and others depicting the more common visual and vestibular illusions

in flight. Sixty-five classic references and a recommended reading list are also provided.

N87-30048# Naval Aerospace Medical Research Lab., Pensacola, Fla.

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY BIBLIOGRAPHY, 1981-1986 Interim Report, 1 Jan. 1981 - 31 Dec. 1986

KATHLEEN S. MAYER Jun. 1987 21 p

(AD-A183837) Avail: NTIS HC A02/MF A01 CSCL 06E

This report lists citations of all unclassified research reports, special reports, monographs, journal articles, and proceedings that were published by the Naval Aerospace Medical Research Laboratory during calendar years 1981 through 1986. Requests for numbered reports (AD XXX XXX) should be directed to DTIC, Cameron Station, Alexandria, Virginia 22314. Requests for articles that were published in the open literature should be addressed to the author, NAMRL, NAS, Pensacola, Florida 32508-5700. GRA

N87-30049\*# Good Samaritan Hospital and Medical Center, Portland, Oreg. Neurological Sciences Inst.

ROLE OF ORIENTATION REFERENCE SELECTION IN MOTION SICKNESS, SUPPLEMENT 2S Semiannual Status Report

ROBERT J. PETERKA and F. OWEN BLACK Oct. 1987 16 p (Contract NAG9-117)

(NASA-CR-181393; NAS 1.26:181393) Avail: NTIS HC A02/MF A01 CSCL 06P

Previous experiments with moving platform posturography have shown that different people have varying abilities to resolve conflicts among vestibular, visual, and proprioceptive sensory signals. The conceptual basis of the present proposal hinges on the similarities between the space motion sickness problem and the sensory orientation reference selection problems associated with benign paroxysmal positional vertigo (BPPV) syndrome. These similarities include both etiology related to abnormal vertical canal-otolith function, and motion sickness initiating events provoked by pitch and roll head movements. The objectives are to explore and quantify the orientation reference selection abilities of subjects and the relation of this selection to motion sickness in humans. The overall objectives are to determine: if motion sickness susceptibility is related to sensory orientation reference selection abilities of subjects; if abnormal vertical canal-otolith function is the source of abnormal posture control strategies and if it can be quantified by vestibular and oculomotor reflex measurements, and if it can be quantified by vestibular and oculomotor reflex measurements; and quantifiable measures of perception of vestibular and visual motion cues can be related to motion sickness susceptibility and to orientation reference selection ability.

# N87-30065# Britannia Airways Ltd., Luton (England). IN-FLIGHT ASSESSMENT OF WORKLOAD USING PILOT RATINGS AND HEART RATE

ALAN H. ROSCOE In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 78-82 Jun. 1987

Avail: NTIS HC A07/MF A01

At present the most used and probably the most reliable methods for assessing pilot workload in flight are based on some form of subjective reporting by experienced test pilots. Subjective opinions are susceptible to bias and preconcieved ideas and so may occasionally result in false estimates of workload. For more than 15 years subjective reporting at RAE Bedford has been augmented by recording their heart rates. At first pilots described workload in a relatively unstructured manner but the need for some form of rating scale was soon apparent. After much trial and error, a 10 point rating scale using the concept of spare capacity was developed. The overall design is based on the Handling Qualities Rating Scale of Cooper and Harper. During the past 8 year a number of flight trials have used pilot ratings and heart rate responses to assess workload. The rationale for using heart rate in assessing pilot workload is based on the concept of neurological arousal. The technique is described and examples of

its use are given. Also listed and briefly discussed are limitations and pitfalls of the technique. Author

#### 53

#### **BEHAVIORAL SCIENCES**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

#### A87-50947

THE DEVELOPMENT OF AN ALGORITHM FOR PREDICTING THE SUCCESS OF AN OPERATOR'S ACTIVITY ON THE BASIS OF A SMALL LEARNING SAMPLE [RAZRABOTKA ALGORITMA PROGNOZIROVANIIA USPESHNOSTI DEIATEL'NOSTI OPERATOROV PRI MALOI OBUCHAIUSHCHEI VYBORKE]

A. I. KHORISHKO, IU. V. GORSKII, IU. V. ASTAPOV, and V. V. KORMACHEV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), April 1987, p. 33-35. In Russian.

#### A87-51162

## PART-TASK TRAINING STRATEGIES IN SIMULATED CARRIER LANDING FINAL-APPROACH TRAINING

DENNIS C. WIGHTMAN (U.S. Navy, Naval Training Systems Center, Orlando, FL) and FRANK SISTRUNK (South Florida, University, Tampa, FL) Human Factors (ISSN 0018-7208), vol. 29, June 1987, p. 245-254. refs

The effect of selected part-task training strategies on transfer to simulated carrier landing is investigated. Fourty male students ranging in age from 18-28 years were taught the final approach phase of the carrier landing tasks using a conventional takeoff and landing simulator. The students were tested for four training conditions: (1) whole task with normal lag; (2) whole task with progressively increased lag; (3) segmented task with normal lag; and (4) segmented task with progressively increased lag. The motor-skill aptitudes of the subjects are also assessed. It is observed that training under the task segmentation strategy produces better transfer to the task than does the whole approach training strategy. The relation between aptitude and training strategy is examined, and it is determined that the segmentation training is more useful for low-aptitude subjects.

# A87-51164\* California State Univ., Hayward. HESITATIONS IN CONTINUOUS TRACKING INDUCED BY A CONCURRENT DISCRETE TASK

STUART T. KLAPP, PATRICIA A. KELLY, and ALLAN NETICK (California State University, Hayward) Human Factors (ISSN 0018-7208), vol. 29, June 1987, p. 327-337. Previously announced in STAR as N86-29503. refs (Contract NCC2-223)

Subjects performed a continuous visually-guided pursuit tracking task with the right hand. From time to time (intervals averaging 30 sec) an auditory tone appeared signaling the subjects to perform a discrete response with the left hand. The presence of this tone was frequently associated with a hesitation in right-hand tracking which lasted 1/3 sec or longer. The rate of occurrence of these hesitations was about the same when the left-hand response involved a choice between competing responses as when the left hand responded in a predetermined direction. Hesitations occurred for three different mechanical tracking manipulanda using different controlling muscles, and appeared to be due to freezing rather than to relaxation of muscular action. The rate of occurrence of hesitations declined with practice, and this improvement in right-hand performance was accompanied by an improvement in performance of the concurrent left-hand response. The presence of hesitations, and their reduction with practice, can be interpreted within several viewpoints. Author

A87-51165\* Toronto Univ. (Ontario).

# A CLOSED-LOOP CAUSAL MODEL OF WORKLOAD BASED ON A COMPARISON OF FUZZY AND CRISP MEASUREMENTS TECHNIQUES

NEVILLE MORAY, BARBARA KING, BURHAN TURKSEN, and KEITH WATERTON (Toronto, University, Canada) Human Factors (ISSN 0018-7208), vol. 29, June 1987, p. 339-348. (Contract NAGW-429)

Fuzzy and crisp measurements of workload are compared for a tracking task that varied in bandwidth and order of control. Fuzzy measures are as powerful as crisp measures, and can under certain conditions give extra insights into workload causality. Both methods suggest that workload arises in a system in which effort, performance, difficulty, and task variables are linked in a closed loop. Marked individual differences were found. Future work on the fuzzy measurement of workload is justified.

**A87-52092\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### **ESTIMATION OF LOCAL SPATIAL SCALE**

ANDREW B. WATSON (NASA, Ames Research Center, Moffett Field, CA) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 4, Aug. 1987, p. 1579-1582. refs

The concept of local scale asserts that for a given class of psychophysical measurements, performance at any two visual field locations is equated by magnifying the targets by the local scale associated with each location. Local scale has been hypothesized to be equal to cortical magnification or alternatively to the linear density of receptors or ganglion cells. Here, it is shown that it is possible to estimate local scale without prior knowledge about the scale or its physiological basis.

#### A87-54098

## INTERACTION BETWEEN COLOUR AND MOTION IN HUMAN VISION

V. S. RAMACHANDRAN (California, University, La Jolla) Nature (ISSN 0028-0836), vol. 328, Aug. 13, 1987, p. 645-647. Research supported by the University of California. refs

Evidence is presented that suggests that the human visual system extracts certain conspicuous image features based on luminance constrast, and that the signals derived from these are then attributed to other features on the object. Specifically, it is found that when either illusory contours or random-dot patterns are moved in the vicinity of a color-border, the color border will also seem to move in the same direction even though it is physically stationary.

C.D.

#### A87-54099

## PARALLEL PROCESSING OF MOTION AND COLOUR INFORMATION

THOM CARNEY (California, University, Berkeley), MICHAEL SHADLEN (Brown University, Providence, RI), and EUGENE SWITKES (California, University, Santa Cruz) Nature (ISSN 0028-0836), vol. 328, Aug. 13, 1987, p. 647-649. NIH-supported research. refs

A novel example is described in which the visual system simultaneously exhibits binocular rivalry and vision that integrates signals from both eyes. This apparent contradiction is resolved by postulating parallel visual processes devoted to the analyses of color and motion information. Counterphased gratings are viewed dichoptically such that for one eye the grating is composed of alternating yellow and black stripes (luminance) while for the other it is composed of alternating red and green stripes (chrominance). When the gratings are fused, a moving grating is perceived. A consistent direction of motion can only be achieved if left and right monocular signals are integrated by the nervous system. Yet the apparent color of the binocular percept alternates between red-green and yellow-black. These observations demonstrate the segregation of processing by the early motion system from that affording the perception of color.

N87-29081# Joint Publications Research Service, Arlington, Va. SCIENTIFIC THEORETICAL PROBLEMS OF VALIDATING THE SYSTEM FOR SOCIOPSYCHOLOGICAL SCREENING OF FLIGHT PERSONNEL

V. L. MARISHCHUK and V. I. YEVDOKIMOV In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, no. 2, March - April 1987 p 1-6 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 4-7

Avail: NTIS HC A08/MF A01

Basic psychoprophylactic measures of medical expertise, professional training and psychological selection are given. Proper development of these measures will contribute to flight safety and pilot longevity.

Author

## N87-29083# Joint Publications Research Service, Arlington, Va. ALCOHOL, EMOTIONS, STRESS AND PERFORMANCE

L. G. POLEVOY and L. L. STAZHADZE In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 14-27 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 12-21

Avail: NTIS HC A08/MF A01

A survey is given of the history of alcohol consumption and of the effects of alcohol on stress, the emotions, and performance. It is concluded, based on the experience accumulated from Canadian and American pilots, that treatment and rehabilitation of alcoholoc pilots should be based on modern concepts of stable pathological systems and their elimination by the production of stable, functional antagonistic anti-systems.

# N87-29086# Joint Publications Research Service, Arlington, Va. EFFECT OF LINEAR, IMPACT AND VIBRATION ACCELERATIONS ON ACCURACY OF OPERATOR IMPLEMENTATION OF STRENGTH LOAD PROGRAMS

I. N. KOROLEVA, S. V. PETUKHOV, and YU. O. BULAYEV In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 46-50 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 34-37

Avail: NTIS HC A08/MF A01

The factors which influence the accuracy with which motor commands are actualized were investigated. The study concentrated on linear acceleration, vibration at a frequency of about 23 Hz, and impact acceleration. The force applied to hand sticks or foot levers was recorded by means of electromechanical sensors. It was demonstrated that impact acceleration caused normal men to underestimate their own muscle efforts. As a rule, this led to a greater than prescribed application of strength. It is very important to note that acceleration acting from right to left or left to right (in the frontal plane) produced nonsymmetric pressure by the right and left limbs.

# N87-29093# Joint Publications Research Service, Arlington, Va. DISTINCTIONS OF PSYCHOSOMATIC CORRECTION OF PERFORMANCE DURING CONTINUOUS LONG-TERM WORK

A. I. SKRYPNIKOV and A. K. YEPISHKIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 86-90 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, Mar. - Apr. 19887 p 59-62

Avail: NTIS HC A08/MF A01

It has been shown by experiment that autogenic training exerts a positive effect on the performance of operators working continuously for a long time. Their efficiency depends on their skill, current health state, and the time of the day. Depending on these factors, autogenic training may increase the quality of operator's work bt 7 to 49 percent.

Author

# N87-29094# Joint Publications Research Service, Arlington, Va. INVESTIGATION OF CRITICAL FUSION FREQUENCY IN MAN DURING EXPOSURE TO NOISE

I. N. DANTSIG and A. V. DIYEV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 91-96 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 62-66

Avail: NTIS HC A08/MF A01

The critical frequency of flicker fusion in the central and four peripheral points of the retina was investigated in twelve test subjects, during and after 1 hour exposure to wide band noise of 95 dBA. The subjects showed two types of response: three displayed an increase and nine a decrease of the flicker fusion critical frequency as compared to the control level. The changes showed individual variations. No correlation was found between the sign of changes in the parameter and its pretest level or the retinal site of registration.

# N87-29098# Joint Publications Research Service, Arlington, Va. METHOD OF ENHANCING INTERFERENCE RESISTANCE OF OPERATOR PERFORMANCE

YE. T. PETRENKO and L. A. YERMUKHAMETOVA In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 117-119 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 78-79 Avail: NTIS HC A08/MF A01

A method was developed to improve man's work capacity by conditioning motor resistance to interference. The method is based on the effect on man of photic and acoustic signals in the rhythm of the basic frequency of his electroencephalogram. The Alpha-rhythm 2 unit, training routines, and results are described.

Author

# N87-29106# Joint Publications Research Service, Arlington, Va. REVIEW OF POTEGAL BOOK ON SPATIAL ABILITIES OF MAN

A. A. GYURDZHIYAN and M. POTEGAL, ed. *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 148-152 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, Mar. - Apr. 1987 p 94-96

Avail: NTIS HC A08/MF A01

The views of representatives of different specialities about the problem of spatial orientation are reviewed. The role of sensory systems, age-related aspects, the role of heredity, the involvment of cerebral sensory systems, age-related aspects, the role of heredity, and the involvement of the cerebral cortex and subcortical structures in the formation of human spatial orientation are the main areas discussed.

Author

# N87-29107# Joint Publications Research Service, Arlington, Va. PSYCHOLOGICAL CONTROL OF HEALTH STATUS DURING LONG-TERM EXPOSURE TO LONGITUDINAL ACCELERATIONS

V. A. PONOMARENKO, A. A. OBOZNOV, and D. YU. ARKHANGELSKIY *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 32-36 15 Jun. 1987 Transl. into ENGISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 24-27

Avail: NTIS HC A08/MF A01

It was demonstrated by centrifugal studies that, from the psychological point of view, an operator's activities when exposed to acceleration are complex and require continuous mental regulation of the health state. During exposure to acceleration, it is important to develop in the operator a specific mental property

- the skill to distribute attention between the operator's tasks and the mental regulation of his own health. Author

N87-29115# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Anthropotechnik und Simulation.

#### REFINEMENT OF THE EYE-POINT-OF-REGARD MEASURE-MENTS WITH HELICOPTER PILOTS IN A FLIGHT EXPERIMENT

RAINER UCKERMANN, HANS RADKE, and KLAUS WENDIGGENSEN Nov. 1986 54 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1073)

(DFVLR-FB-86-61; ISSN-0171-1342; ETN-87-90049) Avail: NTIS HC A04/MF A01; DFVLR, Cologne, West Germany DM 23

The NAC-4 Eye Mark Recorder was tested in flight in order to make eye-point-of-regard measurements in helicopters simple and accurate. Twelve pilots served as subjects. It was tested whether a helmet mounting of the apparatus improves the wearing quality without deteriorating the accuracy of the measurements. The results show that the helmet-mounted apparatus can work much better, while the quality of the measurements is as good as with the original equipment. The new configuration is especially suitable for use in long duration experiments.

N87-29116 Toronto Univ. (Ontario). Inst. for Aerospace Studies.

## FLIGHT SIMULATION MOTION-BASE DRIVE ALGORITHMS. PART 3: PILOT EVALUATIONS

L. D. REID and M. A. NAHON Dec. 1986 194 p (UTIAS-319; ISSN-0082-5255) Avail: Issuing Activity

Full six degrees-of-freedom of motion of a synergistic motion-base was studied. Three forms for these algorithms were considered: classical linear washout, optimal control, and coordinated adaptive washout. It was felt that the latter two techniques might provide some advantages over the classical, which is currently employed in most commercial flight simulators. The goals were to: develop the necessary equations, implement the necessary real-time software, and evaluate the performance of the software with the help of airline pilots in a complete flight simulation. The simulated aircraft and the flight scenarios employed during the evaluation process are described. The experimental plan and data gathering process are outlined fully. Both subjective pilot ratings and objective performance measures were obtained from seven pilots who evaluated ten different motion-base drive algorithm cases. In addition to using a direct pilot rating technique, about half of the experimental trials were used to obtain paired comparison results for four of the ten algorithm cases. The pilot ratings, pilot comments, and objective measures were analyzed and conclusions are presented based on this. The results highlight both pilot preferences in motion-base drive algorithms and the nature of the pilot variability in assessing motion quality.

**N87-29505**# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).

# STUDY OF ANTICIPATION MECHANISMS IN THE AERONAUTICAL ENVIRONMENT [ETUDE DES MECANISMES D'ANTICIPATION EN AERONAUTIQUE]

R. AMALBERTI, CL. VALOT, and J.-P. MENU /n AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 14 p Feb. 1987 In FRENCH Avail: NTIS HC A14/MF A01

Pilot behavior during anticipation activities is discussed. These types of activities make use of the ability to mentally represent the result of changes produced in a given situation, allowing for related events and real action potentials. Anticipation activities may take place at various levels including initial mission planning and necessitated in-flight changes thereto, during the use of standard procedures to accomplish various flight maneuvers and other highly routine acts, and during the acquisition and transfer of information to and from the hardware system using its displays and controls. Both behavioral observation and interview techniques with experienced and inexperienced pilots were used to reveal

the rules by which these anticipation activities are carried out and how they differ as a function of the specific knowledge of the pilot at a given point in time and the available time to consider alternate responses.

M.G.

N87-29506# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Helicopter and Military Aircraft Group.

#### THE TASK TÁXONOMY METHOD: A BASIS FOR AN EXPERT SYSTEM ON HUMAN RELIABILITY

R. SEIFERT and K. BRAUSER /n AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 8 p Feb. 1987

Avail: NTIS HC A14/MF A01

A survey of human error (HE), its definition, nature of HE and the categorization of HE's, causes and prevention measures is described. Then a HE rating scale is introduced, which allows the assignment of HE probability (HEP) values measured into 10 reliability classes (RC). Based on HEP values measured for a number of human performances, a Task Taxonomy Method is developed. This method allows the assignment of a relative weight to all task factors and to all performance shaping factors involved in the task performance. The task taxonomy method is a tool to predict the HEP and RC of tasks allocated to man. Such a predictive tool is used for analysis, definition and design of man machine systems. Rules of an Expert System are described which facilitates the application and use of the task taxonomy method.

N87-30050# Air Force Human Resources Lab., Brooks AFB,

SPATIAL ABILITY AS A PREDICTOR OF FLIGHT TRAINING PERFORMANCE Interim Report, Jan. 1982 - Sep. 1986

THOMAS R. CARRETTA Jul. 1987 15 p

(AD-A183141; AFHRL-TP-86-70) Avail: NTIS HC A02/MF A01 CSCL 05I

Spatial ability has been demonstrated to be related to performance of a variety of tasks including several military enlisted jobs and piloting aircraft. This paper examined the relationship between performance on spatial ability task (i.e., the Mental Rotation Test) and flight training performance for 1,939 United States Air Force Undergraduate Pilot Training (UPT) candidates. Performance on the Mental Rotation Test was not related to completion of training, but was related to a recommendation for specialized training after UPT. Pilot candidates who made quick, consistent, and accurate judgements were more likely to be recommended for fast-jet training (Fighter-Attack-Reconnaissance or FAR). This was consistent with the current practice of selecting the best-performing student pilots for follow-on training in FAR aircraft.

N87-30051# Naval Aerospace Medical Research Lab., Pensacola, Fia.

## TRACKING A LASER-PROJECTED HORIZON INDICATOR Interim Report

J. M. LENTZ, G. T. TURNIPSEED, and W. C. HIXSON May 1987 20 p

(AD-A183384; NAMRL-1330) Avail: NTIS HC A02/MF A01 CSCL 01D

We did not evolve in motion and acceleration environments typical of military aviation, and we lack sense organs to cope with these environments. Even though the vestibular and visual system function properly in these environments, the brain accurately interprets them without visual or tactile contact with some fixed spatial reference point such as the Earth's horizon. In the airplane, this reference is provided by a gyro-stabilized artificial horizon instrument. Individuals differ widely in their ability to extract visual information from this attitude indicator and mentally integrate it with information from other body sensors. Consequently, failure to assimilate all of this information can result in disorientation, erratic motor performance, or intuitively correct but grossly incorrect control decisions. One of the more promising recent attempts to combat inflight spatial disorientation has focused on the development of Peripheral Vision Horizon Devices (PVHD) suitable for installation in operational aircraft. This paper describes a series

of laboratory experiments directed at explaining some of the psychophysiological characteristics of the PVHD significant to its operational application.

N87-30052# Letterman Army Inst. of Research, San Francisco, Calif.

VISUAL INPUT REQUIREMENTS RELATING TO PURSUIT TRACKING ACCURACY Report, Feb. 1985 - Jun. 1986

KENNETH R. BLOOM and HARRY ZWICK Jun. 1987 23 p

(AD-A183445; LAIR-241) Avail: NTIS HC A02/MF A01 CSCL

The interaction between visual function and pursuit tracking performance was measured in 10 human volunteers who participated in three daily 1-hr sessions involving two target sizes (18 min arc and 6 min arc - 1 min arc = 0.28 mrad), two target intensities (photopic = 25 cd/sq m, mesopic = .76 cd/sq m, and two directions of horizontal target motion. Pursuit tracking performance was measured by a computerized video digitizing system, developed at LAIR, during 20-sec tracking trials. Analysis of variance showed significant main effects for target luminance and under mesopic target conditions, target size on pursuit tracking accuracy, pointing to the need to delineate the visual requirements of visual motor tasks to assess the effects of battlefield laser exposure.

N87-30053# Georgia Inst. of Tech., Atlanta. Systems Engineering

## ENHANCEMENT OF HUMAN PERFORMANCE IN MANUAL TARGET ACQUISITION AND TRACKING Final Report, Dec. 1984

DENNIS J. FOLDS, JEFFREY M. GERTH, and WILLIAM R. ENGELMAN May 1987 48 p (Contract F33615-83-D-0601)

(AD-A183549; USAFSAM-TR-86-18) Avail: NTIS HC A03/MF A01 CSCL 05I

A review and analysis of the literature pertaining to human performance in manual target acquisition and tracking tasks is presented. The emphasis is on the identification of factors which enhance performance, particularly those related to training and practice. Three major areas are reviewed: (1) typical patterns of performance in simple target acquisition and tracking tasks; (2) the effects of various training and practice regiments on the development of tracking proficiency; and (3) the impact of dual-task conditions on performance of tracking tasks. A framework for interpreting the various theoretical constructs and empirical findings covered in the literature is offered. This framework is based on the general notion of response organization, and embraces both the process of organization and the result of that process. A major issue which has not been addressed in the literature is how the impact of dual-task conditions on response organization may be lessened (or recovery hastened) by appropriate training. An experiment was conducted to address this issue.

# N87-30060# McDonnell-Douglas Corp., Long Beach, Calif. MENTAL WORKLOAD MEASUREMENT IN OPERATIONAL AIRCRAFT SYSTEMS: TWO PROMISING APPROACHES

MICHAEL BIFERNO In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 44-51 Jun. 1987

Avail: NTIS HC A07/MF A01

When evaluating aircraft systems, the most useful mental workload (MWL) measures are those which can be employed inflight or full mission simulations. This requires measures to be noninterfering, relatively unobtrusive, and provide estimates of operationally relevant MWL while maintaining high levels of validity and reliability. In the context of automated systems, the strategy was to define MWL as language based mental activity and to develop subjective ratings (opinion scale) in the short term and event related brain potential (ERP) measures in the long term. Subjective ratings are being employed to estimate the required degree of attention to perform: information processing, mental operations, and actions. This organization aids in the identification of undesirable MWL levels associated with system displays, logic,

and controls. In addition to providing a quantitative workload rating, this technique elicits verbal explanations if high MWL levels are reported.

#### 54

## MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

#### A87-50949

THE PROBLEMS OF AIRCRAFT MICROCLIMATE (REVIEW OF THE LITERATURE) [PROBLEMY MIKROKLIMATA V. SAMOLETAKH /OBZOR LITERATURY/]

A. N. AZHAEV, I. D. MALININ, and E. A. LUSHCHIKOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), April 1987, p. 37, 38. In Russian. refs

The changes of temperature inside the front and back compartments of an aircraft during different stages of flight are discussed with emphasis on low-altitude flights in hot environments, which pose the particular danger of heat stress to aircraft personnel. Consideration is given to the ranges of ambient temperature necessary for the maintenance of comfort and of the ability to safely operate an aircraft during normal flight as well as during high-speed maneuvers. Special attention is given to preventive measures, such as air-conditioned clothing and clothing equipped with a portable water-cooling system.

#### A87-51979#

**DEVELOPMENT OF A SMALL-SIZED SPACE MANIPULATOR** YOSHITUGU TODA, KAZUO MACHIDA, TOSHIAKI IWATA, MASAO INOUE, KATSUHIKO YAMADA et al. Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 35, no. 401, 1987, p. 294-302. In Japanese, with abstract in English. refs

Future space stations and space factories which require many types of manipulators or robots for assembling and servicing in space, especially demand small-sized manipulators for dexterous tasks. A 1-meter class articulated manipulator with space environment durability and light weight has been developed. This paper presents the system design of the manipulator and development efforts of its components. The design of actuators and a hand, a tribological investigation of mechanical elements in the vacuum environment, the multiprocessor control system, and the dynamic control algorithm of the arm, are described. Author

#### A87-52827

ESTIMATING THE OPERATIONAL QUALITY OF MAN-MACHINE SYSTEMS WITH BIMODAL AND MONOMODAL PRESENTATION OF INFORMATION [OTSENKA KACHESTVA FUNKTSIONIRO-VANIIA ERGATICHESKIKH SISTEM PRI BIMODAL'NOM I MONOMODAL'NOM PRED'IAVLENII INFORMATSII]

G. V. LOZHKIN and V. V. SPASENNIKOV (Kievskoe Vysshee Inzhenernoe Radiotekhnicheskoe Uchilishche, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 72, 1986, p. 33-38. In Russian.

The paper presents a comparative characterization of the semiautomated radar tracking of aerial targets for bimodal and monomodal presentation of information. Results of full-scale experiments are presented, and it is shown that the bimodal approach leads to significant accuracy gains in the extraction of plane coordinates: a 15 percent gain in range and a 20 percent gain in azimuth.

B.J.

#### A87-52828

THE HUMAN STRATEGIES IN THE FORMATION OF SUBJECTIVE CONSTRAINTS ON MANUAL-CONTROL PARAMETERS [STRATEGII CHELOVEKA PRI FORMIROVANII SUB'EKTIVNYKH OGRANICHENII NA PARAMETRY RUCHNOGO UPRAVLENIIA]

V. A. CHERNOMORETS (AN USSR, Institut Kibernetiki, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 72, 1986, p. 59-64. In Russian. refs

Consideration is given to the use of the integrality principle to identify a system of subjective constraints used by a human operator in the formation of manual-control parameters. This approach makes it possible to identify the optimal control duration toward which the operator unconsciously strives.

B.J.

#### A87-52829

TAKING ACCOUNT OF RULES IN THE PREDICTION OF THE POSSIBLE STRATEGIES OF ACTIVE PARTNERS [UCHET PRAVIL PRI PROGNOZIROVANII VOZMOZHNYKH STRATEGII AKTIVNYKH PARTNEROV]

V. D. SIABRO (AN USSR, Institut Kibernetiki, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 72, 1986, p. 74-77. In Russian.

The formalization of rules presented to a human operator in a man-machine system is considered. A procedure of automatically taking account of the rules is used to predict possible control straegies for active partners and to choose one's own strategy.

B.I

#### A87-52830

ALGORITHM AND PROGRAM SOFTWARE OF AN INFORMATION/MEASUREMENT SYSTEM FOR EVALUATING THE STATE OF AN OPERATOR [ALGORITMICHESKOE I PROGRAMMNOE OBESPECHENIE INFORMATSIONNO-IZMERITEL'NOI SISTEMY OTSENKI SOSTOIANIIA OPERATORAI

A. P. GRISHANOVICH and V. V. DMITRIEVA (Belorusskii Gosudarstvennyi Universitet, Minsk, Belorussian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 72, 1986, p. 77-80. In Russian. refs

A system for the processing of physiological data has been developed with the aim of investigating the functional states of an operator. The processing involves a set of indices that reflect the various vital functions. The software engineering is described, and it is noted that results of operator-state evaluation are presented in clear tabular and graphic forms.

#### A87-52831

THE SIMULATION OF FLEXIBLE ACTIVITY ALGORITHMS (FOR THE EXAMPLE OF AN OPERATOR-DISPLAY SYSTEM)
[MODELIROVANIE GIBKIKH ALGORITMOV DEIATEL'NOSTI
/NA PRIMERE SISTEMY OPERATOR-DISPLEI/]

A. P. ROTSHTEIN (Tsentral'noe Konstruktorskoe Biuro Informatsionnoi Tekhniki, Vinnitsa, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 72, 1986, p. 87-92. In Russian. refs

An analytical model for evaluating the error performance and implementation time of a flexible model of display-operator activity is examined. The possibility of the interconnected analysis, identification, and optimization of flexible activity algorithms is illustrated by the example of an operator inputting alphanumeric messages from a display into a computer. A general approach to the simulation of flexible algorithms is proposed.

B.J.

#### A87-52990

#### DOSIMETRIC MAPPING INSIDE BIORACK

G. REITZ, H. BUECKER, R. FACIUS (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany), R. BEAUJEAN, W. ENGE (Kiel, Universitaet, West Germany) et al. (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 107-113. BMFT-supported research. refs

Dosimetric results from dosimeters at various locations inside ESA's Biorack are presented. Flown on the D-1 mission, the present experiment used different plastic detectors and emulsions to measure the high linear energy transfer (LET) components of the radiation environment; thermoluminescence dosimeters (LiF) were used for low LET measurements. Data are presented on the total dose, charge, energy, and LET spectra obtained and comparisons are made with the results of previous missions. The necessity of measuring the radiation field as close as possible to the biological system under investigation is demonstrated.

K.K.

**A87-52992\*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

# THE MEASURED RADIATION ENVIRONMENT WITHIN SPACELABS 1 AND 2 AND COMPARISON WITH PREDICTIONS

T. A. PARNELL, J. W. WATTS, JR., G. J. FISHMAN (NASA, Marshall Space Flight Center, Huntsville, AL), E. V. BENTON, A. L. FRANK (San Francisco, University, CA) et al. (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 125-134. refs

(Contract NAS8-34354; NAS8-34340; NAS9-17389)

A set of passive and active radiation detectors was flown as part of the verification flight instrumentation (VFI) in an attempt to measure the radiation environment in the Spacelab (SL) module and on the pallet. SL 1 carried 4 passive and 2 active detector packages which were used to evaluate the radiation environment within the spacecraft and SL 2 carried 2 passive VFI units on the pallet. Dose equivalents of 330 + or - 70 mrem and 537 + or - 37 mrem were measured in the SL 1 module and SL 2 pallet, respectively.

#### A87-53063#

## THE USE OF INDIVIDUAL DIFFERENCES IN INFERRING HUMAN OPERATOR INTENTIONS

NORMAN D. GEDDES (Georgia Institute of Technology, Atlanta) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 31-41. Research sponsored by Lockheed-Georgia Co. refs

Past experiences in the development of human-machine system models have repeatedly shown that while good agreement between the model and human operators in terms of performance statistics could be obtained, the detailed behavior of the model rarely agreed with the observed human behavior. In fact, the behavior of well-trained human operators often shows large variability. As a result of these observations, it is reasonable to suspect that a model of human intentions which attempts to observe a human operator's actions and infer his goals and methods must also consider the role of individual differences in shaping behavior. This paper addresses a number of the issues underlying the concept of using individual differences as a consideration in inferring operator intentions from observed actions.

#### A87-53089

#### **HUMAN CAPABILITIES IN SPACE**

BYRON K. LICHTENBERG (Payload Systems, Inc., Wellesley, MA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986. San Diego, CA, Univelt, Inc., 1987, p. 183-194. (AAS PAPER 86-114)

The role of humans in space is discussed. The crew is concerned with flying the vehicle, operating experiments, participating in biomedical studies, and exploring outside the spacecraft. The use of the crew to construct large structures, such as the Space Station, in space and the functions of the crew on the Space Station are examined.

#### A87-53092

#### **BIOSPHERE II - THE CLOSED ECOLOGY PROJECT**

MARGRET AUGUSTINE (Space Biospheres Ventures, Oracle, AZ) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 243-254. refs

#### (AAS PAPER 86-119)

Biosphere II is a proposed stable, complex, evolving, materially closed, life closed, and energetically open system. The system is to be located at a 2500-acre facility near Tucson, Arizona and it is to contain seven biomes: a tropical rain forest, tropical savannah, marsh, marine, desert, intensive agriculture, and human habitat. The Greenhouse and Tissue Culture complex, which is a model for the Biosphere II, is described, and a model of the system is provided. Applications for the biospheric system include: scientific and ecological management research, refuges for endangered species, and life habitats for manned stations on spacecraft or on other planets.

#### A87-53093

## THE CLOSED ECOLOGY PROJECT - AGRICULTURAL AND LIFE SCIENCES BACKGROUND

CARL N. HODGES (Arizona, University, Tucson) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986. San Diego, CA, Univelt, Inc., 1987, p. 255-271. (AAS PAPER 86-120)

Some of the research that was applied to the development of Biosphere II is discussed. Consideration is given to the use of solar energy to desalt sea water; a desert agricultural environment; animal production inside a controlled environment; and the Land Pavilion project depicting the history of agriculture. Attention is also given to temperature control for the agricultural area of the greenhouse, recycling, and maintaining a clean atmosphere. I.F.

#### A87-53921#

ROBOT MANIPULATORS FOR SAMPLE HANDLING IN SPACE N. E. CABLE (ESA, Mechanical Systems Dept., Noordwijk, Netherlands) ESA Bulletin (ISSN 0376-4265), no. 50, May 1987, p. 73-79.

The application of a robot-manipulator to transport tasks in space is evaluated by designing a robot-manipulator for the Automatic Mirror Furnace Facility of Eureca; skeleton and advanced manipulator designs are proposed. The design of the end-effector devices, grapple fixtures, and process-transport mechanism is examined; a tetrahedral wedge joint has been selected for these devices. The main design requirements for the manipulator involve fitting the manipulator in the limited space of the payload module. Consideration is given to the sensors for the basic operation of the manipulator; the ground testing of the equipment; the use of CAD in the development of the manipulator; the need for processors for each facility; and the electronics and software used to control the manipulator's operation. Computer-graphics generated images of the skeleton and advanced manipulator design are provided.

A87-53979\* Vigyan Research Associates, Inc., Hampton, Va. A SIMULATION MODEL FOR THE ANALYSIS OF SPACE STATION GAS-PHASE TRACE CONTAMINANTS

DANA A. BREWER (Vigyan Research Associates, Inc., Hampton, VA) and JOHN B. HALL, JR. (NASA, Langley Research Center, Hampton, VA) Acta Astronautica (ISSN 0094-5765), vol. 15, Aug. 1987, p. 527-543. refs (Contract NAS1-550; NAS1-17919)

A simulation model for the analysis of gas-phase trace contaminants in the cabin air of the NASA Space Station Reference Configuration was developed at the NASA Langley Research Center. The model predicts changes in trace contaminant concentrations from both physical and chemical sources and sinks as a function of time. Simulations were performed in which values for relative humidity, temperature, radiation intensity, pressure, and initial species concentrations were constrained to values for these parameters measured and modeled in the continental tropics at the earth's surface. Species concentrations simulated using the model compared favorably with concentrations in the continental tropics which demonstrated that the chemical mechanism in the trace contaminant model approximates changes in atmospheric species concentrations. The sensitivity of initial species concentrations to producing changes in additional species concentrations was also assessed. Results from the model indicated that chemical reactions will be important in determining the composition of cabin air in the Space Station. It is anticipated that the trace contaminant model will be useful in assessing the impact of experiments and commercial operations on the composition of the cabin air in the Space Station.

Author

N87-29084# Joint Publications Research Service, Arlington, Va. CONCEPT OF FUNCTIONAL STRENGTH IN THE PROBLEM OF OBJECTIVIZATION OF BIOMECHANICAL SPECIFICATIONS FOR PROTECTIVE AND RESCUE GEAR FOR AIRCRAFT **CREWS** 

A. S. BARER and YU. G. KONAKHEVICH In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 28-31 Transl, into ENGLISH from Kosmicheskava Biologiva i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 21-24

Avail: NTIS HC A08/MF A01

Problems related to the ambiguous formulation of biomedical requirements pertaining to the quality of protection and rescue gear used by aircraft crews are discussed. In order to objectify these requirements, the use of the functional strength concept which reflects both mechanical and functional results of adverse effects is recommended. The potential use of this parameter in developing complex requirements for various programmed and contingent situations and the probability aspects of the problem of evaluating protection and rescue gear is described. Author

N87-29085# Joint Publications Research Service, Arlington, Va. THEORETICAL ANALYSIS OF EFFICACY OF G SUITS WITH EX-POSURE TO CONTINUOUSLY INCREASING ACCELERATIONS B. L. PALETS, M. A. TIKHONOV, A. A. POPOV, D. YU. ARKHANGELSKIY, L. D. PALETS, and R. A. BONDARENKO In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 37-45 15 Jun. 1987 Transl, into ENGLISH from Kosmicheskava Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 27-33 Avail: NTIS HC A08/MF A01

A mathematical model of circulation was employed to examine circulation responses to plus Gz acceleration (the value of which increases linearly at the rate of 1.0 G/sec) using subjects wearing an anti-gravity suit and sitting in a relaxed posture. It was calculated that the anti-gravity suit could compensate for as much as 83 percent of the increment of hydrostatic pressure in leg vessels and as much as 57 percent in abdominal vessels. The suit makes an approximately equal contribution to an increase of the acceleration tolerance threshold. However, the occlusion effect of the anti-gravity suit causes a significant increase of afterload. Author

N87-29097# Joint Publications Research Service, Arlington, Va. MATHEMATICAL MODEL OF PILOT HEAD KINEMATICS **DURING EJECTION INTO AIR FLOW** 

V. I. KHARCHENKO, N. V. GOLOVLEVA, YU. G. KONAKHEVICH, V. A. LYAPIN, A. V. MARYIN, V. KH. PETLYUK, and L. N. SHOLLO In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987 p 110-116 15 Jun. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 2, Mar. - Apr. 1987 p 73-78 Avail: NTIS HC A08/MF A01

The trajectories of head movements in a helmet and velocities of impact contact with the seat and interior of the cockpit were calculated as applied to every stage of the catapulting process, with mass-inertia parameters of the helmets taken into account. Kinematic models were used to describe biomechanic parameters of the head-neck system. Special attention was given to the case of catapulting to the air flow. The effect upon the nod of aerodynamic forces acting on the human body and the catapult ejection seat at air flow velocities of 700 to 800 and 1300 km/h was calculated. Author

N87-29117\*# Honeywell, Inc., Clearwater, Fla. Space and Strategic Avionics Div.

AUTOMATED SUBSYSTEM CONTROL FOR LIFE SUPPORT SYSTEM (ASCLSS) Final Report

ROGER F. BLOCK 15 Jul. 1987 65 p

(Contract NAS9-16895)

(NASA-CR-172003; NAS 1.26:172003) Avail: NTIS HC A04/MF A01 CSCL 06K

The Automated Subsystem Control for Life Support Systems (ASCLSS) program has successfully developed and demonstrated a generic approach to the automation and control of space station subsystems. The automation system features a hierarchical and distributed real-time control architecture which places maximum controls authority at the lowest or process control level which enhances system autonomy. The ASCLSS demonstration system pioneered many automation and control concepts currently being considered in the space station data management system (DMS). Heavy emphasis is placed on controls hardware and software commonality implemented in accepted standards. The approach demonstrates successfully the application of real-time process and accountability with the subsystem or process developer. The ASCLSS system completely automates a space station subsystem (air revitalization group of the ASCLSS) which moves the crew/operator into a role of supervisory control authority. The ASCLSS program developed over 50 lessons learned which will aide future space station developers in the area of automation and controls..

N87-29118\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MOBILE REMOTE MANIPULATOR VEHICLE SYSTEM Patent HAROLD G. BUSH, inventor (to NASA), MARTIN M. MIKULAS, JR., inventor (to NASA), RICHARD E. WALLSOM, inventor (to NASA), and J. KERMIT JENSEN, inventor (to NASA) (Kentron International, Inc., Hampton, Va.) 11 Aug. 1987 17 p 31 Jul. 1985 Supersedes N86-21147 (24 - 11, p 1842) (NASA-CASE-LAR-13393-1; US-PATENT-4,685,535; US-PATENT-APPL-SN-760799; US-PATENT-CLASS-182-63;

US-PATENT-CLASS-182-82; US-PATENT-CLASS-182-223)

Avail: US Patent and Trademark Office CSCL 05H

A mobile remote manipulator system is disclosed for assembly, repair and logistics transport on, around and about a space station square bay truss structure. The vehicle is supported by a square track arrangement supported by guide pins integral with the space station truss structure and located at each truss node. Propulsion is provided by a central push-pull drive mechanism that extends out from the vehicle one full structural bay over the truss and locks drive rods into the guide pins. The draw bar is now retracted and the mobile remote manipulator system is pulled onto the next adjacent structural bay. Thus, translation of the vehicle is inchworm style. The drive bar can be locked onto two guide pins while the extendable draw bar is within the vehicle and then push the vehicle away one bay providing bidirectional push-pull drive. The track switches allow the vehicle to travel in two orthogonal directions over the truss structure which coupled with the bidirectional drive, allow movement in four directions on one plane. The top layer of this trilayered vehicle is a logistics platform. This platform is capable of 369 degees of rotation and will have two astronaut foot restraint platforms and a space crane integral.

N87-29504# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

#### **AUTOMATION AT THE MAN-MACHINE INTERFACE**

WALTER M. HOLLISTER In AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 10 p Feb. 1987

Avail: NTIS HC A14/MF A01

There is a recognized need for automation. However, detailed analysis shows that the term automation is too broad for making specific research recommendations. The specific characteristics vary in kind and degree as a function of the piloting tasks. In some cases, the task should be left entirely to the pilot. In many cases, computer aiding is the best choice. A method for allocating functions between automated systems and the pilot is presented using the theory of divided attention. It describes a structured approach for reducing the control dwell fraction with improved flying qualities. There is a need for fundamental research into the understanding of how the human pilot operates as part of the aircraft and weapons control system.

N87-29507# Washington Univ., St. Louis, Mo.
CLOSING THE MAN-MACHINE LOOP: ON THE USE OF
PHYSIOLOGICAL MEASURES TO AFFECT COMPUTER-CONTROLLED DEVICES

J. A. STERN, G. F. WILSON, and M. THEISSEN (General Dynamics Corp., Fort Worth, Tex.) In AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 5 p Feb. 1987

Avail: NTIS HC A14/MF A01

Results suggest that physiological information: heart rate, eye blink, etc., as well as information about operator performance and system characteristics, could be used to alert the operator, change displays, or permit the hardware to take over certain functions. Utilization of physiological data from the operator must be used with certain cautions in mind. For example, physical exertion causes changes in heart rate. The system would have to be provided with information concerning physical exertion, so that the heart rate data could be appropriately interpreted in a larger context. This is true of the information concerning aircraft performance as well, where the pattern of inputs from various sensors is analyzed in order to make a decision about an action to be taken. Author

N87-29508\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECTS OF DISPLAY-CONTROL I/O, COMPATIBILITY, AND INTEGRALITY ON DUAL-TASK PERFORMANCE AND SUBJECTIVE WORKLOAD

PAMELA S. TSANG (Illinois Univ., Savoy.), SANDRA G. HART, and MICHAEL A. VIDULICH *In* AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 9 p Feb. 1987

Avail: NTIS HC A14/MF A01 CSCL 05H

The utility of speech technology was evaluated in terms of three dual task principles: resource competition between the time shared tasks, stimulus central processing response compatibility, and task integrality. Empirical support for these principles was reviewed. Two studies investigating the interactive effects of the three principles were described. Objective performance and subjective workload ratings for both single and dual tasks were examined. It was found that the single task measures were not necessarily good predictors for the dual task measures. It was

shown that all three principles played an important role in determining an optimal task configuration. This was reflected in both the performance measures and the subjective measures. Therefore, consideration of all three principles is required to insure proper use of speech technology in a complex environment.

Author

N87-29509# Royal Air Force, London (England).
A STUDY OF PILOT FLIGHT INFORMATION CROSSMONITOR-

A STUDY OF PILOT FLIGHT INFORMATION CROSSMONITOR ING PERFORMANCE

V. P. SCHMIT In AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 12 p Feb. 1987 Avail: NTIS HC A14/MF A01

A experiment is discussed which investigated the ability of the pilot to crossmonitor between Head Up display and Head Down instruments. In a situation with high error rates, no subsidiary tasks and with explicit exclusion of troubleshooting (i.e., a best case), results show a low error detection rate, long detection times and significant flying performance decrements while crossmonitoring. Error detection performance is correlated not with the amount of time spent crossmonitoring, but with the frequency at which the pilot chooses to crossmonitor. Extrapolation from the results suggests that, at least for the conditions of this experiment, crossmonitoring should occur every 22 to 23 sec to ensure acceptable error detection. The evidence points clearly to the need to remove the crossmonitoring task from the pilot and make it an automated function for future aircraft.

**N87-29510**# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).

SOPHISTICATED INTEGRAL CONTROL METHODS FOR USE IN FLIGHT [LES MOYENS DE COMMANDE INTEGRES SOPHISTIQUES SERONT-ILS CONCUS POUR ETRE UTILISABLES EN VOL]

J.-P. MENU, G. SANTÜCCI, and R. AMALBERTI In AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 6 p Feb. 1987 In FRENCH Avail: NTIS HC A14/MF A01

The changing nature of display and control requirements for modern aircraft and the various means by which information is transferred to and from the pilot are reviewed. Some of the known factors affecting human performance are discussed including: (1) desaturation and contrast loss in electronically generation information during high illumination inflight conditions; (2) the effects of high acceleration on both foveal and peripheral presentations of information; (3) manual control designs which obscure some settings when engaged; and (4) the improper labelling of display and control devices. The potential use of voice interactive control devices, especially in overcoming problems inherent in multitask situations, is also discussed. Finally, the relative merits of dedicated and multifunctional displays and controls are examined along with the theoretical causes of increased higher cognitive workloads required by multifunction devices.

N87-29516# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France). Lab. Central de Biologie Aerospatiale.

ORGANIZATION OF DISPLAYS IN THE VISUAL SPACE OF THE COMBAT AIRCRAFT PILOT [ORGANISATION DES VISUALISATIONS DANS L'ESPACE VISUEL DU PILOTE D'AVION DE COMBAT]

J.-P. MENU and R. AMALBERTI /n AGARD, Information Management and Decision Making in Advanced Airborne Weapon Systems 12 p Feb. 1987 In FRENCH Avail: NTIS HC A14/MF A01

The psychophysiological problems associated with the specific organization of cockpit displays were examined through laboratory studies and pilot surveys. The response time associated with the transition between head-up and head-down displays was measured under various conditions. It was found that reduced transition times could be obtained through the use of intermediate display concepts. Illumination level and visual adaptation were identified as important factors in the optimal integration of displays.

M.G.

N87-29865\*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.

# THE DESIGN AND DEVELOPMENT OF A MOBILE TRANSPORTER SYSTEM FOR THE SPACE STATION REMOTE MANIPULATOR SYSTEM

THOMAS W. CARROLL In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 93-101 May 1987

Avail: NTIS HC A16/MF A01 CSCL 05H

The analyses, selection process, and conceptual design of potential candidate Mobile Transporter (MT) systems to move the Space Station Remote Manipulator System (SSRMS) about the exposed faces of the Space Station truss structure are described. The actual requirements for a manipulator system on the space station are discussed, including potential tasks to be performed. The SSRMS operating environment and control methods are analyzed with potential design solutions highlighted. Three general categories of transporter systems are identified and analyzed. Several design solution have emerged that will satisfy these requirements. Their relative merits are discussed, and unique variations in each system are rated for functionality.

N87-29866\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## TELEROBOTIC WORK SYSTEM: CONCEPT DEVELOPMENT AND EVOLUTION

LYLE M. JENKINS In its The 21st Aerospace Mechanisms Symposium p 103-110 May 1987 Avail: NTIS HC A16/MF A01 CSCL 05H

The basic concept of a telerobotic work system (TWS) consists of two dexterous manipulator arms controlled from a remote station. The term telerobotic describes a system that is a combination of teleoperator control and robotic operation. Work represents the function of producing physical changes. System describes the integration of components and subsystems to effectively

function of producing physical changes. System describes the integration of components and subsystems to effectively accomplish the needed mission. Telerobotics reduces exposure to hazards for flight crewmembers and increases their productivity. The requirements for the TWS are derived from both the mission needs and the functional capabilities of existing hardware and software to meet those needs. The development of the TWS is discussed.

N87-29867\*# Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn.

#### TRACTION-DRIVE, SEVEN-DEGREE-OF-FREEDOM TELERO-BOT ARM: A CONCEPT FOR MANIPULATION IN SPACE

D. P. KUBAN and D. M. WILLIAMS In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 111-130 May 1987

Avail: NTIS HC A16/MF A01 CSCL 05H

As man seeks to expand his dominion into new environments, the demand increases for machines that perform useful functions in remote locations. This new concept for manipulation in space is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges the best characteristics of teleoperation and robotic technologies. The design goals for the telerobot, a mechanical description, and technology areas that must be addressed for successful implementation are presented and discussed. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator capable of obstacle avoidance.

Author

N87-30054# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

#### THE PRACTICAL ASSESSMENT OF PILOT WORKLOAD

ALAN H. ROSCOE, ed. (Britannia Airways Ltd., Luton, England ) Jun. 1987 141 p

(AGARD-AG-282; ISBN-92-835-1546-3) Avail: NTIS HC A07/MF A01

Whether one is attempting to reduce workload in the cockpit of a combat aircraft to improve mission effectiveness, or to optimise workload levels on the flight deck of a civil airliner to improve safety, it is important to be able to assess workload in practical terms. In the case of the civil transport aircraft the findings of the President's Task Force on Crew Complement have underlined the need to assess workload in flight reliably in order to satisfy certification requirements for new aircraft. The main purpose of this report is to provide guidance for the assessment of pilot workload in practical situations. The various techniques available for assessing pilot workload are introduced and briefly reviewed. Some techniques that have been successful inflight are presented along with techniques for assessing workload for the purpose of aircraft certification.

# N87-30055# Ergometrics Technology, Inc., Dayton, Ohio. IN-FLIGHT WORKLOAD ASSESSMENT USING EMBEDDED SECONDARY RADIO COMMUNICATIONS TASKS

CLARK A. SHINGLEDECKER In Advisory Group for Aerospace Research and the Practical Assessment of Pilot Workload p 11-14 Jun. 1987

Avail: NTIS HC A07/MF A01

The embedded secondary task methodology was developed to improve the practical utility of dual task measures for inflight workload assessment, while retaining many of the scientific advantages associated with traditional laboratory secondary tasks. The concept of the embedded secondary task is based on the hypothesis that instrumentation limitations, task intrusion, and poor operator acceptance can be minimized by designing secondary tasks which are fully integrated with system hardware and with the crewmember's conception of the mission environment. By their nature, such tasks are realistic components of crewstation activity, yet their performance can be manipulated and measured independently of the primary activities of interest. While several classes of aircrew activity are potential candidates for isolation and use as embedded tasks, radio communication tasks are particularly suitable for this purpose. Such tasks closely resemble the nonadaptive discrete secondary tasks used in numerous workload studies and have many properties of good measurement tasks. Measurement techniques are described and examples of use are given along with limitations. Author

# N87-30056# Douglas Aircraft Co., Inc., Long Beach, Calif. USE OF TASK TIMELINE ANALYSIS TO ASSESS CREW WORKLOAD

G. STONE, R. K. GULICK, and R. F. GABRIEL In Advisory Group for Aerospace Research and the Practical Assessment of Pilot Workload p 15-31 Jun. 1987

Avail: NTIS HC A07/MF A01

As systems have become more sophisticated, the role of humans in operating and maintaining them has grown more complex. There has been a steadily growing recognition that human characteristics, particularly limitations and abilities, must be considered in some depth in system design if design objectives are to be met. The size and role of the crew represent critical decisions. Mission performance has a direct relationship to the ability of the crew to carry out all of the required functions. The use of workload measures to assess the viability of a selected crew complement as well as other crew interfaces was considered. Several techniques are listed which are used to assess workload including task/timeline analysis measures. It appears to be the most easily implemented and could meet most of the established criteria. A model was developed to utilize this workload measure in the design, verification of design improvements, and certification

#### 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

of recent aircraft. This approach is presented and discussed in detail. E.R.

N87-30057# Boeing Co., Seattle, Wash.
PILOT SUBJECTIVE EVALUATION OF WORKLOAD DURING A
FLIGHT TEST CERTIFICATION PROGRAMME

FRANK T. RUGGIERO and DELMAR M. FADDEN In advisory Group for Aerospace Research and the Practical Assessment of Pilot Workload p 32-36 Jun. 1987

Avail: NTIS HC A07/MF A01

To date there is no agreed upon definition of mental workload and therefore there is no agreement on how it should be measured. Three aspects of mental workload are agreed upon: it is a multidimensional construct, a clear distinction must be maintained between imposed mental load (task load) and the mental load as experienced (subjective load), and the use of subjective ratings should be central to any investigation of workload. The Pilot Subjective Evaluation (PSE) process developed in conjunction with the FAA is outlined which supplements the analytical, simulator, and flight test crew workload evaluation techniques used to demonstrate compliance with the minimum crew size requirement regulations.

N87-30058# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. for Flight Guidance.

THE USE OF SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE IN A COMPLEX FLIGHT TASK

F. V. SCHICK and R. L. HANN (Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.) *In* Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 37-41 Jun. 1987 Avail: NTIS HC A07/MF A01

Techniques for measuring mental workload can be divided into three basic categories: physiological, behavioral, and subjective. One particular technique belonging to the subjective group of methods, which always use some form of operator self-report (e.g., rating scales or questionnaires) is discussed. In order to deal with the undesirable properties of subjective methods, a procedure known as the Subjective Workload Assessment Technique (SWAT) was developed. In SWAT, subjective workload is defined as being composed of three dimensions: time load, mental effort load, and psychological stress load. This method is introduced and discussed.

**N87-30059**# Illinois Univ., Urbana-Champaign. Dept. of Psychology.

WORKLOAD METHODOLOGY

EMANUEL DONCHIN and CHRISTOPHER D. WICKENS In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 42-43 Jun. 1987 Avail: NTIS HC A07/MF A01

The goal of the proposed technique is to employ two converging methodologies to track the workload changes during the ILS approach to landing. The two methodologies, based upon the Event Related Brain Potential (ERP) and the Sternberg Memory Search task, provides information that is both sensitive, detecting variations in resource demand when they occur, and diagnostic, localizing these changes within the multidimensional space underlying human processing resources. Each of these techniqes are briefly described. The ERP is a transient series of voltage oscillations in the brain that can be recorded from the scalp in response to the occurrence of a discrete event. The Sternberg Memory Search requires the pilot to identify whether or not a displayed character is one of a set of characters that is held in short term memory.

Author

N87-30061# Ergometrics Technology, Inc., Dayton, Ohio.
CORTICAL EVOKED RESPONSE AND EYEBLINK MEASURES
IN THE WORKLOAD EVALUATION OF ALTERNATIVE LANDING
SYSTEM DISPLAYS

R. D. ODONNELL and GLENN WILSON In Advisory Group for Aerospace Research and the Practical Assessment of Pilot Workload p 52-55 Jun. 1987 Prepared in cooperation with Aerospace Research Labs., Wright-Patterson AFB, Ohio Avail: NTIS HC A07/MF A01

Based on the results of a number of studies, it was decided to construct a battery of physiological tests, each of which had shown some promise in laboratory studies of being sensitive to various aspects of workload. This Neuropsychological Workload Test Battery (NWTB) is undergoing validation testing in several simulator environments. Two of the most promising measures from this battery are the transient cortical evoked response and several analyses of eyeblink behavior. It is becoming clear that these techniques can contribute complementary types of information on the amount of workload being experienced by the operator, and could form the basis of a measurement system which would tap both global and specific aspects. Rationales are given for these techniques along with a description and examples of their use.

E.R.

**N87-30062\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

IN-FLIGHT ASSESSMENT OF WORKLOAD USING INSTRUMENT SCAN

J. R. TOLE (Digital Analysis Corp., Reston, Va.) and R. L. HARRIS, SR. *In* Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 56-59 Jun. 1987 Avail: NTIS HC A07/MF A01

During instrument flight, the pilot obtains information concerning aircraft state by cross checking or scanning the flight instruments. The exact method of scanning the instrument panel varies from pilot to pilot but there are some basic features common to a good scan pattern. The method discussed may be considered a candidate for workload studies with piloting tasks which will invoke a regular visual scan (spatial/temporal pattern of eye movements) during instrument flight. It is important to point out that instrument scan by itself is not a complete indicator of workload nor is task attention necessarily associated with where the pilot happens to be looking at a particular instant. However, whenever instrument scan is required in a piloting task, analysis of scanning behavior may yield important direct or indirect information concerning workload.

N87-30063# British Aerospace Dynamics Group, Hatfield (England). Test Pilots Office.

FLIGHT TEST EVALUATION OF CREW WORKLOAD. PART 1: AIRCRAFT CERTIFICATION FOR A MINIMUM CREW OF TWO PILOTS

W. A. WAINWRIGHT In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 60-68 Jun. 1987

Avail: NTIS HC A07/MF A01

The method developed to certificate the BAe 146 for operation by a minimum crew of two pilots to regulations is described. The method is based primarily on subjective assessment of workload but employs objective data to support that assessment. All the data were collected from one flying phase and no flight or ground simulator assessments were performed, neither were the results correlated with any previous evaluation. The flight test evaluation used a variety of assessment methods, including practical demonstration, qualitative and quantative subjective evaluation, subjective comparison with similar aircraft types, and objective physiological evaluation. All confirmed that the crew workload on the BAe 146 was compatible with operation by a minimum crew of 2 pilots. This method is briefly discussed.

N87-30064# Royal Air Force Strike Command, High Wycombe (England).

MEASUREMENT OF AIRCREW WORKLOAD DURING LOW-LEVEL FLIGHT. PART 1: A COMPARISON BETWEEN IN-FLIGHT AND POST FLIGHT ASSESSMENT METHODS

I. GAVIN LIDDERDALE In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 69-77 Jun. 1987

Avail: NTIS HC A07/MF A01

The results of a comparative study of the use of inflight and postflight methods of subjective workload assessments in a modern military combat aircraft are presented. The assessments were made during a demanding low level flight task which was undertaken to assess workload and define crew cooperation procedures for pilot and navigators during terrain following flight. The inflight workload assessments were made using a modified version of the Cooper-Harper scale which is referred to as the Bedford Scale. Postflight ratings were made using a method of pairwise comparisons based on a method reported by Saaty. Other measures, including physiological recordings and voice tapes were also taken during the trials to provide additional data. From the results of the trials, it was found that both methods of subjective workload assessment produced similar results and a rank order analysis gave high correlations. A hypothetical Recce/Attack task for fast jet aircraft was chosen to illustrate the application of the workload measurement techniques described. The technique relies on the use of subjective ratings scales and physiological measures supported by voice recordings and flight data recordings. Author

N87-30066# Cranfield Inst. of Tech., Bedford (England). Applied Psychology Unit.

#### THE ASSESSMENT OF WORKLOAD IN HELICOPTERS

HELEN C. MUIR and ROBERT ELWELL In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 83-89 Jun. 1987
Avail: NTIS HC A07/MF A01

In aviation an assessment of workload is often used as one component in a program of research. The objective of the research may vary from an assessment of the activities of the crew to an evaluation of either cockpit modifications or operational changes. Thus workload assessments will form one of a series of stages in the research. A model is presented in which the stages of the investigation which will proceed and follow the workload assessment are described. An application of this approach to the assessment of workload in helicopters is used to illustrate the practical implications of the model.

N87-30067# Airbus Industrie, Blagnac (France).

ASSESSING WORKLOAD FOR MINIMUM CREW CERTIFICATION. PART 1: STATIC WORKLOAD ANALYSIS AND PERFORMANCE ANALYSIS

J. J. SPEYER, A. FORT, J. P. FOUILLOT, and R. D. BLOMBERG In Advisory Group for Aerospace Research and the Practical Assessment of Pilot Workload p 90-115 Jun. 1987 Prepared in cooperation with Centre de Recherches de Medecine Aeronautique, Paris (France) and Dunlap and Associates, Inc., Norwalk, Conn.

Avail: NTIS HC A07/MF A01

The critical importance of man machine interaction has been recognized in the field of aircraft handling qualities. The recognition that man machine interaction is part of a complex information transfer process between pilots, the aircraft and ground facilities is relatively new. Classical are the systematic methods for assessing aircraft handling qualities, which inspired the approach to workload assessment presented. Also classical topics in flight test are the determination of static and dynamic stability, the former indicating the tendency of an aircraft to return to its equilibrium position, the latter indicating the way an aircraft returns to its equilibrium position. Analogous to the complementarity of these evaluations, the Static Taskload and the Dynamic Workload Methods were developed. Both methods address particular workload functions and factors. These methods are briefly described and discussed.

N87-30068\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### **MEASUREMENT OF PILOT WORKLOAD**

SANDRA G. HART *In* Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 116-122 Jun. 1987

Avail: NTIS HC A07/MF A01

A multistage process for evaluating the workload of a five-minute segment of flight including approach and landing for a typical transport aircraft was described. The goal of the analysis was to compare the workload of the two pilots. Four types of measurement techniques were suggested: Analytic (a preliminary task and time line analysis identified task requirements and target performance levels); Performance (flight path control, communications, and interval production); Physiological (heart rate and heart rate variability); and Subjective ratings (a multidimensional technique developed at NASA Ames).

N87-30069# National Aerospace Lab., Amsterdam (Netherlands).

## INVESTIGATION OF WORKLOAD MEASURING TECHNIQUES: A THEORETICAL AND PRACTICAL FRAMEWORK

RENE C. VANDEGRAAFF In Advisory Group for Aerospace Research and The Practical Assessment of Pilot Workload p 123-130 Jun. 1987

Avail: NTIS HC A07/MF A01

A number of considerations involved in the setting up of an investigation dealing with the problem of being able to draw conclusions from a variety of experimental measures in a complex task situation are discussed. Several implications are pointed out, such as the problem of dealing with contradictory outcomes, the designating of artefacts, and the problem of formulating final conclusions with the (a priori) availability of a superior method for evaluating other methods. An experimental program is outlined which is based on (normal) approach conditions for civil fixed wing aircraft. The task conditions in this experiment are selected to serve as an operationally based framework for comparing different workload evaluation methods, for evaluating the effects of specific task conditions and for investigating the strategies needed for drawing final conclusions from a variety of outcomes.

Author

N87-30070# Oak Ridge National Lab., Tenn.
DYNAMIC TASK ALLOCATION FOR A MAN-MACHINE
SYMBIOTIC SYSTEM

L. E. PARKER and F. G. PIN Jun. 1987 55 p (Contract DE-AC05-84OR-21400) (DE87-011950; ORNL/TM-10397; CESAR-87/08) Avail: NTIS HC A04/MF A01

This report presents a methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation. This report addresses a symbiotic system containing two symbiotic partners which work toward controlling a single manipulator arm for the execution of a series of sequential manipulation tasks. It is proposed that an automated task allocator use knowledge about the constraints/criteria of the problem, the available resources, the tasks to be performed, and the environment to dynamically allocate task recommendations for the man and the machine. The presentation of the methodology includes discussions concerning the interaction of the knowledge areas, the flow of control, the necessary communication links, and the replanning of the task allocation. Examples of task allocation are presented to illustrate the results of this methodology. DOE

N87-30071# Army Research Inst. of Environmental Medicine, Natick, Mass.

EFFECTIVENESS OF AN AIR COOLED VEST USING SELECTED AIR TEMPERATURE, HUMIDITY AND AIR FLOW RATE, COMBINATIONS

STEPHEN R. MUZA, NANCY A. PIMENTAL, and HENRY M. COSIMINI Jun. 1987 36 p

(AD-A183298; USARIEM-T-22-87) Avail: NTIS HC A03/MF A01 CSCL 05H

The effectiveness of reducing thermal strain in soldiers by supplying an air-cooled vest with each of four different dry bulb (db) and dew point (dp) temperatures and air combinations is evaluated. The four combinations were selected to determine minimal air conditioning requirements for several military vehicles. Six male soldiers attempted four, 300-min heat exposures (49 C db, 20 C dp) at metabolic rates of either 175 and 315 W. The soldiers wore chemical protective clothing over the combat vehicle crewman uniform and the air-cooled vest. Air supplied to the vest ranged from 22.5 to 27.5 C db, 15.5 to 21.1 dp at flow rates of either 10 or 14.5 cfm. Endurance times with the vest were 272 to 300 min (175 W) and 159 to 220 min (315 W). In summary, at the 175 W metabolic rate the vest condition which provided the 10 cfm air flow was effective in reducing thermal strain and extending endurance time. At the 315 W metabolic rate, typical of a tank commander or loader, either vest condition would extend endurance time, but would not be as effective in reducing thermal strain as the vest combinations tested in an earlier study.

N87-30072# Naval Aerospace Medical Research Lab., Pensacola,

## INCOMPATIBILITY OF THE M-1 MANEUVER WITH US NAVY TACTICAL AIRCRAFT OXYGEN SYSTEMS Final Report

J. T. WHITE and L. M. MORIN Sep. 1986 9 p (AD-A183731; NAMRL-TM-86-1) Avail: NTIS HC A02/MF A01 CSCL 06J

A spectrum of clinical symptoms consisting of grey-out, black-out, and G-induced loss of consciousness has been identified in pilots of high performance aircraft. The M-1 maneuver used in conjunction with reclined seats and inflated G-suit provides significant protection against these symptoms. Centrifuge-trained United States Navy tactical aircraft pilots have recently reported a decreased ability to perform the M-1 maneuver while using the MBU-12P oxygen mask and CRU-79/P oxygen regulator. This report reviewed the performance specifications of these devices and compared them with published pulmonary flow rates. We found this oxygen system to interfere with the performance of the M-1 and other anti-G maneuvers. Further research is needed to characterize pulmonary flow rates during the performance of the M-1 maneuver in order to make recommendations for breathing system standards aboard high performance aircraft.

55

#### **PLANETARY BIOLOGY**

Includes exobiology; and extraterrestrial life.

#### A87-53000

### HYPOTHESES ON THE APPEARANCE OF LIFE ON EARTH (REVIEW)

K. DOSE (Mainz, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 181-186. refs

Past theories on the origin and evolution of life (until about 1865) are discussed as well as contemporary hypotheses. Particular attention is given to the self-organization of spontaneously formed biomolecules into early precursors of life, their stepwise evolution via (postulated) protocells to (postulated) progenotes, and the

Darwinian evolution from progenotes to the three kingdoms of contemporary organisms (archaebacteria, eubacteria, and eukaryotes). The hypothesis that life came to earth from a remote place in the universe (panspermia) has been reconsidered but there is evidence indicating that spores can survive only a relatively short journey within the solar system.

K.K.

#### A87-53001

#### **EXOBIOLOGY REVISITED**

H. P. KLEIN (Santa Clara, University, CA) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 187-192. refs

The early history and recent progress in exobiology is reviewed. Tables are presented listing important questions concerning the early history of the 'biogenic' elements, the environment of the primordial earth, and the early and late stages of biological evolution. Finally, a general conceptual summary of the content of and the philosophy behind modern exobiology is given in a figure, including some of the space missions or activities that have contributed to the clarification of the first-order biological questions.

**A87-53002\*** National Aeronautics and Space Administration. • Ames Research Center, Moffett Field, Calif.

## SPACE STATION GAS-GRAIN SIMULATION FACILITY APPLICATION TO EXOBIOLOGY

C. P. MCKAY, C. R. STOKER (NASA, Ames Research Center, Moffett Field CA), J. MORRIS, G. CONLEY (Colorado, University, Boulder), and D. SCHWARTZ (SETI Institute, Los Altos, CA) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 195-206. refs

The technical issues involved in performing experiments on the behavior and properties of aerosols in a microgravity environment provided by the Space Station are reviewed. The displacement of a particle resulting from g-jitter for ballistic, Knudsen, and Stokes flow regimes is examined in detail, and the radiation, acoustic, electrostatic, and electromagnetic mechanisms for the control of this motion are described. The simulation of organic haze production on Titan has been selected as an example experiment for detailed study. The purpose of this experiment was to simulate the photolysis of methane and the subsequent formation of the organic haze particles in the Titan upper atmosphere. B.J.

#### A87-53003

## RADIATION STABILITY OF ORGANIC MATTER IN LIQUID AND FROZEN H2O, NH3 AND WATER-AMMONIA MIXTURES

B. NEBELING, K. ROESSLER, and G. SCHMITZ (Kernforschungsanlage Juelich, GmbH, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 207-210. refs

The redox properties of irradiated liquid and frozen H2O, NH3, and H2O/NH3 mixtures at 298 and 77 K towards some simple organic molecules have been checked by injecting carrier-free C-11 atoms and analyzing their chemical state by means of radiochromatography. The reactions and the stability of organic products versus radiation dose depend on temperature, phase state, mobility of radicals, their concentration, and reactivity. Especially dangerous are the reactive OH and O2H radicals which oxidize organic material to inorganic CO2. Highest stability has been found at low temperatures and for systems containing H-donors, which reduce the concentration of oxidizing radicals. The fact that many bodies in space consist of H2O-ice with NH3 and CH4 additives at temperatures between 10 and 150 K is promising in view of the survival of organic matter under high doses of radiation. Author

A87-53005\* California Univ., Berkeley.

# SURVEY OF EARTH ORBITAL TÉLESCOPES AND THEIR POTENTIAL FOR EXOBIOLOGY

JILL C. TARTER (California, University, Berkeley; SETI Institute, Los Altos) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 219-226. (Contract NCC2-36)

The opportunities that exist for observational exobiology (OE) are examined. The potential uses of free-flying spacecraft, the Space Shuttle, and the Space Station for OE are considered. Proposed experiments are summarized, including research on extrasolar planetary systems, the solar nebula and its analogs, the solar system, giant-planet atmospheres, Titan, comets and asteroids, and molecules in space. A table listing appropriate NASA and ESA telescopes is given.

# A87-53007

# SEARCH FOR ORGANIC MOLECULES IN THE OUTER SOLAR SYSTEM

TH. ENCRENAZ (Paris, Observatoire, Meudon, France) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 237-246. refs

Published data from ground and space observations revealing the presence of complex organic molecules in the outer solar system are compiled in tables and spectra and discussed. Detections of IR lines of organic species are reported for the atmospheres of Titan, Jupiter, Saturn, Uranus, and Neptune, and near the nucleus of Comet Halley. Consideration is given to plans for further research, including larger antennae and interferometers on the ground; advanced space observatories such as ISO, SIRTF, Caesar, Vesta, and CRAF; and the ESA Comet Nucleus Sample Return mission.

# A87-53008

# PHYSICAL-CHEMICAL LIMITS FOR THE STABILITY OF BIOMOLECULES

E. W. LANG (Regensburg, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 251-255. refs

The effects of temperature (T) and pressure (p) on reactions among biopolymers and between biopolymers and water (and hence on the effective stability of the biomolecules) are discussed, summarizing the results of published experimental investigations. Consideration is given to the reversible undercooling of aqueous solutions of some biomolecules, the cold lability of proteins, the self-dissociation of water and the weakening of hydrogen bonds at high T and p (leading to accelerated hydrolysis of biomolecules), and increases in hydrophobic reactions at high T. Results for the t-butanol/water system (Woznyj et al., 1984; Woznyj, 1985) are examined in more detail. The upper stability limit on T is estimated at about 400 K, but the p values encountered on earth (up to about 120 MPa) are found to have little effect on biomolecule stability at T less than 400 K.

# **A87-53009\*** Drexel Univ., Philadelphia, Pa. **MOLECULAR ASPECTS OF ADAPTATION TO EXTREME COLD ENVIRONMENTS**

LEONARD FINEGOLD (Drexel University, Philadelphia, PA) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 257-264. Research supported by the American Philosophical Society. refs

(Contract NATO-84/0667; NSF DPP-83-14180; NSG-7337)

Some of the various strategies adopted by living organisms for survival at low temperatures are discussed from the molecular and membrane points of view. Two examples of connections between biological cold adaptation and the molecular level are considered: (1) antifreeze proteins in fish from cold sea water and (2) the fluidity characteristics of cell membranes in a wide variety of organisms. Emphasis is placed on the occurrence of s-phases.

B.J.

# A87-53010\* Florida State Univ., Tallahassee. THE ANTARCTIC COLD DESERT AND THE SEARCH FOR

# TRACES OF LIFE ON MARS

E. I. FRIEDMANN (Florida State University, Tallahassee) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 265-268. refs (Contract NSG-7337; NSF DPP-83-14180)

The cryptoendolithic microoganisms that live inside rocks in the frigid Ross Desert of Antarctica can serve as a terrestrial model for what may have happened to life forms on Mars when the planet became dry and cold. Trace fossils of microbial rock colonization exist in Antarctica, and similar structures could he an easier target for life-detection systems than fossils of cellular structures.

Author

**A87-53011\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

# EXOBIOLOGY AND FUTURE MARS MISSIONS - THE SEARCH FOR MARS' EARLIEST BIOSPHERE

CHRISTOPHER P. MCKAY (NASA, Ames Research Center, Moffett Field, CA) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 269-285. NASA-supported research. refs

The primordial Mars may have possessed a thick carbon dioxide atmosphere, with liquid water common on the surface, similar in many ways to the primordial earth. During this epoch, billions of years ago, the surface of Mars could have been conducive to the origin of life. It is possible that life evolved on Mars to be later eliminated as the atmospheric pressure dropped. Analysis of the surface of Mars for the traces of this early Martian biota could provide many insights into the phenomenon of life and its coupling to planetary evolution.

# A87-53014

# SURVIVAL UNDER SPACE VACUUM - BIOCHEMICAL ASPECTS

K. DOSE (Mainz, Universitaet, West Germany) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 16, no. 12, 1986, p. 307-312. refs (Contract BMFT-01-QV-179/13)

It is suggested that a number of biophysical and chemical effects have a crucial function in the inactivation of biological systems induced by long-term exposure to vacuum. These effects include the disruption of hydrophobic bonds (e.g., in membranes and proteins), the induction of conformational changes by removal of hydrate water (particularly in DNA and proteins), and the formation of new covalent bonds by condensation and elimination reactions (the formation of DNA-protein crosslinks).

# A87-53551

# **CLAY MINERALS AND THE ORIGIN OF LIFE**

A. GRAHAM CAIRNS-SMITH, ED. (Glasgow, University, Scotland) and HYMAN HARTMAN, ED. (MIT, Cambridge, MA) Cambridge and New York, Cambridge University Press, 1986, 204 p. No individual items are abstracted in this volume.

The role of clays in the origins of life is examined in papers presented at a workshop held at Glasgow University on July 18-24, 1983. Topics addressed include protoplasm and the gene theory, the clay hypothesis, and the use of SEM to analyze clay minerals. Consideration is given to layer silicate structures, cation patterns

and information storage, interstratified clays, flocculation/deflocculation, the hydrothermal strategy, clay synthesis using hydroxide silica gels, and the role of organic complexing agents in the synthesis of clay. Also discussed are the origin of clays on earth, Precambrian clays, the synthesis of iron-rich clays in an anaerobic environment, dysoxic environments as models for primordial mineralization, clays on Mars and in meteorites, clay catalysis, the essential conditions for life, four crystal genes, and the pedigree principle.

# A87-53826

# 1986 ISSOL MEETING, 5TH, BERKELEY, CA, JULY 21-25, 1986, **PROCEEDINGS**

JAMES P. FERRIS, ED. (Rensselaer Polytechnic Institute, Troy, Meeting sponsored by the International Society for the Study of the Origin of Life. Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, 238 p. For individual items see A87-53827 to A87-53845.

The volume includes papers on the quantitative aspects of photoprecipitation and the banded iron-formations, the possible biological origin of banded iron-formations from hydrothermal solutions, the formation of amino acid precursors in the reaction of atomic carbon with water and ammonia at 77K, and the prebiotic synthesis of imidazole-4-acetaldehyde and histidine. Consideration is given to the nonenzymatic synthesis of coenzymes uridine diphosphate glucose and cytidine diphosphate choline and other phosphorylated metabolic intermediates, kinetic analysis of the template effect in ribooligoguanylate elongation, selective emergence and survival of early polypeptides in water, and the energy metabolism of a thermoacidophilic archaebacterium. Sulfolobus acidocaldarius. Special attention is given to the origin and evolution of photosynthetic reaction centers, and the structural elements and organization of the ancestral translational machinery.

# A87-53831

# THE FORMATION OF AMINO ACID PRECURSORS IN THE REACTION OF ATOMIC CARBON WITH WATER AND AMMONIA

DANIEL W. MCPHERSON, KAZI RAHMAN, IRIS MARTINEZ, and PHILIP B. SHEVLIN (Auburn University, AL) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 275-282. refs (Contract NSF CHE-84-01198)

When atomic carbon is condensed on a surface at 77 K containing ammonia and water, glycine, N-methylglycine, alanine, beta-alanine, aspartic acid, and serine are generated. It is postulated that these reactions may mimic those which occur when an extraterrestrial carbon atom condenses on a frozen surface coated with water and ammonia and may provide a route to extraterrestrial amino acids. Experiments designed to elucidate the mechanisms of amino acid formation under these conditions have been carried out.

# A87-53832

# STUDIES ON THE STRUCTURE OF HCN OLIGOMERS

KIMIKO UMEMOTO, MAKOTO TAKAHASI, and KATSUYUKI YOKOTA (International Christian University, Mitaka, Japan) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 283-293. refs

Infrared, NMR, and chemical analyses were used to study the structure of the water-insoluble fraction of HCN oligomers prepared by introducing HCN gas into concentrated aqueous ammonia. After four days, the precipitated solid oligomers were washed with water and dryed in vacuo before analyses. It was found that nearly half of the nitrogen atoms contained in the oligomers are of the primary amino type, and the other half are involved in the -C=N- type bonding. The oligomers contain about 0.2 atom of oxygen per atom of nitrogen; it is suggested that oxygen is introduced into the oligomers from the solvent water through a hydrolytic process to form a C=O bond in place of the C=NH. Acetylated oligomers show IR absorption and NMR spectra characteristic for acetyl amide. The molecular weights of acetylated oligomers, estimated by gel permeation chromatography, ranged from 300 to 900. I.S.

# A87-53833\* Houston Univ., Tex. PREBIOTIC SYNTHESIS OF IMIDAZOLE-4-ACETALDEHYDE AND HISTIDINE

CHUN SHEN, J. ORO, LILY YANG (Houston, University, TX), and STANLEY L. MILLER (California, University, La Jolla) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 295-305. refs (Contract NGR-44-005-002; NAGW-20)

The prebiotic synthesis of imidazole-4-acetaldehyde and imidazole-4-glycol from erythrose and formamidine has been demonstrated as well as the prebiotic synthesis of imidazole-4ethanol and imidazole-4-glycol from erythrose, formaldehyde, and ammonia. The maximum yields of imidazole-4-acetaldehyde, imidazole-4-ethanol, and imidazole-4-glycol obtained in these reactions are 1.6, 5.4 and 6.8 percent respectively, based on the erythrose. Imidazole-4-acetaldehyde would have been converted to histidine on the primitive earth by a Strecker synthesis, and several prebiotic reactions would convert imidazole-4-glycol and imidazole-

Author

A87-53834\* Houston Univ., Tex.

4-ethanol to imidazole-4-acetaldehyde.

# NON-ENZYMATIC SYNTHESIS OF THE COENZYMES, URIDINE DIPHOSPHATE GLUCOSE AND CYTIDINE DIPHOSPHATE CHOLINE, AND OTHER PHOSPHORYLATED METABOLIC INTERMEDIATES

A. MAR, J. DWORKIN, and J. ORO (Houston, University, TX) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 307-319. refs (Contract NGR-44-005-002)

Using urea and cyanamide, the two condensing agents considered to have been present on the primitive earth, uridine diphosphate glucose (UDPG), cytidine diphosphate choline (CDP-choline), glucose-1-phosphate (G1P), and glucose-6-phosphate (G6P) were synthesized under simulated prebiotic conditions. The reaction products were separated and identified using paper chromatography, thin layer chromatography, enzymatic analyses, and ion-pair reverse-phase high performance liquid chromatography. The possibility of nonenzymatic synthesis of metabolic intermediates on the primitive earth from simple precursors was thus demonstrated.

# A87-53835\* Instituto Politecnico Nacional, Mexico City. LIPOSOMES WITH POLYRIBONUCLEOTIDES AS MODEL OF PRECELLULAR SYSTEMS

ISABEL BAEZA, MIGUEL IBANEZ, CARLOS SANTIAGO, ANTONIO LAZCANO, CARLOS ARGUELLO (Instituto Politecnico Nacional, Mexico City, Mexico) et al. (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 321-331. Research supported by the Instituto Politecnico Nacional. refs

(Contract NGR-44-005-002)

Three types of liposomes were prepared under anoxic conditions: from dipalmitoyl phosphatidyl choline (DPPC), from egg yolk phosphatidyl choline (PC), and from PC with cholesterol (PC:Chol). These were used for encapsulation of poly(U) and poly(C). It was found that 36 to 70 percent of the available liposome lipids and 2 to 5 percent of the polyribonucleotides could be entrapped. An enhanced encapsulation of poly(U) and poly(C) by all three types of liposomes was observed in the presence of 0.001 to 0.01 M Zn(2+), with the effect being greatest with DPPC. The presence of 1.0 M urea inhibited the formation of PC **A87-53836\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

# KINETIC ANALYSIS OF THE TEMPLATE EFFECT IN RIBOOLIGOGUANYLATE ELONGATION

ANASTASSIA KANAVARIOTI (Nasa, Ames Research Center, Moffett Field, CA) and DAVID H. WHITE (Santa Clara, University, CA) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 333-349. Research supported by the U.S. National Research Council. refs (Contract NCC2-166)

The paper presents kinetic studies on the reaction of elongation of the 3-prime-5-prime-linked ribooligoguanylates with guanosine 5-prime-phospho-2-methylimidazolide (2-MelmpG) in the presence or absence of a complementary template, the polycytidylic acid. In the absence of poly(C), the reaction leads to three isomeric oligomers that are elongated by one monomer unit: the 3-prime-5-prime linked, the 2-prime-5-prime linked, and the pyrophosphate, formed in a ratio of 1:2:5. In the presence of the template, the reaction is 20-fold faster and yields products (n + 1), (n + 2), (n + 3), etc., as long as 2-MelmpG is available. The formation of the natural, 3-prime-5-prime-linked isomer, is enhanced selectively by 140-fold at 37 C, and its relative yield increases with decreasing temperature.

# A87-53837\* Nijmegen Univ. (Netherlands).

# NUCLEIC ACID-LIKE STRUCTURES. II - POLYNUCLEOTIDE ANALOGUES AS POSSIBLE PRIMITIVE PRECURSORS OF NUCLEIC ACIDS

ALAN W. SCHWARTZ, J. VISSCHER, C. G. BAKKER, and J. NIESSEN (Nijmegen, Katholieke Universiteit, Netherlands) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 351-357. refs (Contract NGR-05-067-001)

Activated derivatives of purine-containing deoxynucleosidediphosphates spontaneously oligomerize to pyrophosphate- linked oligodeoxynucleotide analogs. These analogs are of potential interest as models of primitive, polynucleotide precursors. The efficiency of oligomerization (ImpdGpIm and ImpdApIm much greater than ImpdIpIm) appears to reflect a combination of stacking forces and the specific geometric orientations of the stacked units. Under favorable conditions, chain lengths greater than 20 have been obtained for oligomers containing pdGp in the absence of a template. In the presence of a complementary template, the activated derivatives of pdGp and pdAp oligomerize much more extensively. An acyclo-analog of G has also been shown to undergo template-directed oligomerization on poly(C). These observations suggest the possibility that primitive information transfer might have evolved in much simpler systems and that this function was taken over by polynucleotides at a later stage in evolution.

# A87-53838

# BINDING OF DNA HAIRPINS TO AN ASSEMBLER-STRAND AS PART OF A PRIMORDIAL TRANSLATION DEVICE

ULRICH BAUMANN (Max-Planck-Institut fuer biophysikalische Chemie, Goettingen, West Germany): (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 359-366. refs

A crucial event in the process leading to the origin of life is the emergence of a simple translation device. To approach experimental realization of this device the binding ability of short DNA hairpins to complementary oligonucleotides fixed on a solid support was investigated. The binding is achieved by base pairing between the loop nucleotides of the hairpins containing different numbers of adenosine residues and oligothymidylates covalently linked to cellulose. The loop has to consist of at least five nucleotides to achieve binding. The exact number of established base pairs was determined in two ways. First, the elution temperatures of hairpins and those of oligoadenylates which had the length of the loop were compared. Secondly, the architecture

of the loop was analyzed by means of the single-strand-specific nuclease from mung bean acting as structural probe. Only n-2 of n loop nucleotides of a hairpin are able to form base pairs. Therefore, a strong evidence for the formation of a triplet of base pairs between primeval tRNA and mRNA sufficient to stabilize the complex enzyme-free is given.

# A87-53839

# SELECTIVE EMERGENCE AND SURVIVAL OF EARLY POLYPEPTIDES IN WATER

ANDRE BRACK (CNRS, Centre de Biophysique Moleculaire, Orleans, France) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 367-379. refs

Evidence is presented for the selective condensation of amino acids in water, as well as for the selective resistance of condensation products to degradation, indicating that oligopeptides essential to primitive cells could be formed in the environment of primitive earth. It is shown that N-carboxyanhydrides (formed when active esters of amino acids are left in the presence of bicarbonate ions or when N,N-prime-carbonyldiimidazole is used as the condensing agent) are good candidates for chemical selection in water. The specific stability of water-soluble beta-pleated sheet conformation against chemical degradation suggests a possible way to accumulate homochiral sequences made of hydrophilic and hydrophobic residues; amino acids with branched aliphatiac side-chains are selected but those with short linear aliphatic side-chains are not.

# A87-53840

# SEARCH FOR CATALYTIC PROPERTIES OF SIMPLE POLYPEPTIDES

B. BARBIER and A. BRACK (CNRS, Centre de Biophysique Moleculaire, Orleans, France) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 381-390. refs

The catalytic effects of polypeptides on the nucleotide polymerization (in the absence of any preformed polynucleotide template) and/or degradation were investigated by testing sequential copolymers of Ala and Glu, water-soluble polypeptides based on Arg, and poly(Glu-Ser-Glu). No catalytic effect was observed with any of these, although poly(Glu-Ser-Glu) was found to modify the course of nucleotide polymerization by favoring the 2-prime-5-prime internucleotide linkage. On the other hand, the polypeptides containing Arg were found to significantly enhance the hydrolysis of oligoadenylates at pH values between 7.5 and 12 and at temperatures below 40 C.

# A87-53842

# THE RELATIONSHIP BETWEEN THE BIOSYNTHETIC PATHS TO THE AMINO ACIDS AND THEIR CODING. I - THE ALIPHATIC AMINO ACIDS AND PROLINE

JOHN H. MCCLENDON (Nebraska, University, Lincoln) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 401-417. refs

The genetic code could not have been fixed until the means for biosynthesis of the amino acids was at hand. The biosynthetic enzymes could not be optimized until the genetic code ceased to be rearranged. Therefore the development of the code and the development of the biosynthesis of the amino acids occurred concurrently. The present day biosynthetic pathways of amino acids, examined from this point of view, help to explain the present set of coded amino acids, in particular the absence of norvaline, norleucine, homoserine, ornithine, and alpha-aminobutyric acid. An order of development of biosyntheses is also proposed. Lysine was first, followed by valine and isoleucine. The more common primordial amino acids did not need biosyntheses so early. The central pathways of metabolism probably developed in response to a need for amino acid biosynthesis.

# 55 PLANETARY BIOLOGY

A87-53844\* Roswell Park Memorial Inst., Buffalo, N. Y. STRUCTURAL ELEMENTS AND ORGANIZATION OF THE ANCESTRAL TRANSLATIONAL MACHINERY

R. REIN, S. SRINIVASAN, J. MCDONALD, G. RAGHUNATHAN, and M. SHIBATA (Roswell Park Memorial Institute, Buffalo, NY) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 431-438. refs (Contract NSG-7305)

The molecular mechanisms of the primitive translational apparatus are discussed in the framework of present-day protein biosynthesis. The structural necessities of an early adaptor and the multipoint recognition properties of such an adaptor are investigated on the basis of structure/function relationships found in a contemporary system and a molecular model of the contemporary transpeptidation complex. A model of the tRNA(Tyr)-tyrosyl tRNA synthetase complex including the positioning of the disordered region is proposed; the model is used to illustrate the required recognition properties of the ancestor aminoacyl synthetase.

# A87-53845

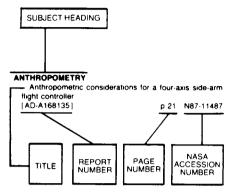
# INFORMATION THEORY AND THE GENETIC CODE

A. FIGUREAU (Lyon I, Universite, Villeurbanne, France) (International Society for the Study of the Origin of Life, Meeting, 5th, Berkeley, CA, July 21-25, 1986) Origins of Life (ISSN 0302-1688), vol. 17, no. 3-4, 1987, p. 439-449. refs

The key processes involved in the functioning of the genetic code as an information system in the replication, transcription, and translation processes are examined. A systematic approach is devised, which makes it possible to integrate the most fundamental characteristics of the code in a theoretical scheme in which many features of the code table can be interpreted as resulting from a unique principle of best resistance against the effects of mutations. Some consequences of this new principle are explored in the most simple models that can be built for the origin and evolution of the genetic code.

# AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 305)

# Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

# ABIOGENESIS

Binding of DNA hairpins to an assembler-strand as part of a primordial translation device p 329 A87-53838

Specific absorption rate distributions in a heterogeneous model of the human body at radiofrequencies [PB87-201356] p 313 N87-30040

# ACCELERATION (PHYSICS)

Effects of rectilinear acceleration, caloric and optokinetic stimulation of human subjects in the Spacelab D-1 p 308 A87-52998

Psychological control of health status during long-term exposure to longitudinal accelerations

# p 317 N87-29107

# ACCELERATION STRESSES (PHYSIOLOGY)

JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March

p 309 N87-29080 [JPRS-USB-87-004] Theoretical analysis of efficacy of G suits with exposure

to continuously increasing accelerations p 321

Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086

Adaptive and cumulative effects on dogs of regular p 304 N87-29087 exposure to +Gz accelerations

Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101

Psychological control of health status during long-term exposure to longitudinal accelerations

# p 317 N87-29107

**ACCELERATION TOLERANCE** Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085

Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087 Psychological control of health status during long-term exposure to longitudinal accelerations

p 317 N87-29107 Incompatibility of the M-1 maneuver with US Navy

tactical aircraft oxygen systems p 326 N87-30072

# **ACCIDENT PREVENTION**

Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel p 316 N87-29081

# ACETALDEHYDE

Prebiotic synthesis of imidazole-4-acetaldehyde and p 328 A87-53833 histidine ACIDITY

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to overheating p 301 ed to cooling or p 301 A87-53534 ACTIVE CONTROL

Taking account of rules in the prediction of the possible strategies of active partners p 319 A87-52829 ADAPTATION

Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087 Adaptability of the rat hypokinetic heart to afterload, and the role of nervous regulation
ADRENAL METABOLISM p 304 N87-29092

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to cooling or overheating p 301 A87-53534 Status of Alpha 1-adrenergic regulation of stroke volume p 304 N87-29091 in hypokinetic rats

# AEROEMBOLISM

Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114

# AEROSPACE ENVIRONMENTS

Dosimetric mapping inside Biorack

p 320 A87-52990 JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March [JPRS-USB-87-004]

p 309 N87-29080 Charging of a man in the wake of the shuttle

p 311 N87-29111 Automated Subsystem Control for Life Support System (ASCLSS)

[NASA-CR-172003] p 321 N87-29117 AEROSPACE MEDICINE

Medical problems associated with long-duration space [AAS PAPER 86-115]

p 308 A87-53090 Biological effectiveness of helium ions and protons of p 301 relativistic energies p 301 USSR Space Life Sciences Digest, issue 13 A87-53539

[NASA-CR-3922(15)] p 304 N87-29079 JPRS Report: Science and technology. USSR: Space

Biology and Aerospace Medicine, Volume 21, No. 2, March [JPRS-USB-87-0041 p 309 N87-29080

Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel p 316 N87-29081

Automated analysis of vectorcardiograms in space p 310 N87-29099 Changes in rat hemopolesis as a result of the combined effect of accelerations, radiation and radiation-modifying

p 304 N87-29101 Activities report in aerospace medicine

[ETN-87-90153] p 311 N87-29112 Aerospace medicine and biology: A continuing

bibliography with indexes (supplement 302) [NASA-SP-7011(302)] p 314 p 314 N87-30041

USSR Report: Life Sciences. Biomedical and behavioral sciences

[JPRS-UBB-87-009] Interaction of macula and semicircular canals in angular p 314 N87-30045 stabilization of man in space

Naval Aerospace Medical Research Laboratory bibliography, 1981-1986 [AD-A183837] p 315 N87-30048

### AIR COOLING

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations [AD-A1832981 p 326 N87-30071

# AIR FLOW

Mathematical model of pilot head kinematics during lection into air flow p 321 N87-29097 ejection into air flow

# AIRCRAFT CARRIERS

Part-task training strategies in simulated carrier landing p 315 A87-51162 final-approach training

# AIRCRAFT COMPARTMENTS

The problems of aircraft microclimate (Review of the literature) p 319 A87-50949

# AIRCRAFT CONTROL

Automation at the man-machine interface

# p 322 N87-29504 AIRCRAFT MANEUVERS

Study of anticipation mechanisms in the aeronautical p 317 N87-29505 environment

# AIRCRAFT PILOTS

Alcohol, emotions, stress and performance

p 316 N87-29083 of flight training

Spatial ability as a predictor performance [AD-A183141] p 318 N87-30050

### AIRCRAFT SAFETY

Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel p 316 N87-29081

# **ALCOHOLS**

Alcohol, emotions, stress and performance

p 316 N87-29083

# ALGORITHMS

The development of an algorithm for predicting the success of an operator's activity on the basis of a learning sample p 315 A87-50947 Flight simulation motion-base drive algorithms. Part 3:

Pilot evaluations [UTIAS-319] p 317 N87-29116

# ALKALINITY

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to cooling or p 301 A87-53534 overheating

# **ALLOCATIONS**

Dynamic task allocation for a man-machine symbiotic svstem

[DE87-011950] p 325 N87-30070

# **ALTITUDE ACCLIMATIZATION**

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of rats to high altitude p 295 A87-51107

The effect of adaptation to cold and of short-term exposure to cold on the resistance of animals to hypoxic hvpoxia p 295 A87-51108

# AMINO ACIDS

Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in the primitive ocean p 303 A87-53830

The formation of amino acid precursors in the reaction of atomic carbon with water and ammonia at 77 K p 328 A87-53831

The relationship between the biosynthetic paths to the amino acids and their coding. I - The aliphatic amino acids and proline p 329 A87-53842

**AMMONIA** Radiation stability of organic matter in liquid and frozen H2O, NH3 and water-ammonia mixtures

p 326 A87-53003 The formation of amino acid precursors in the reaction

of atomic carbon with water and ammonia at 77 K p 328 A87-53831

# AMPHIBIA

Amphibian egg cytoplasm response to altered g-forces and gravity orientation p 297 A87-52979 ANTARCTIC REGIONS

The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010

# **ANTIOXIDANTS** Species variation in lung antioxidant enzyme activities

p 296 A87-52217

Adaptability of the rat hypokinetic heart to afterload, and p 304 N87-29092 the role of nervous regulation ARCHITECTURE (COMPUTERS)

Automated Subsystem Control for Life Support System (ASCLSS)

ÎNASA-CR-1720031 p 321 N87-29117

ARM (ANATOMY)

related to different body positions

Dynamics of fluid turnover in human extremities as p 309 N87-29088

ARMED FORCES (UNITED STATES) Spatial ability as a predictor of flight training

performance [AD-A183141] p 318 N87-30050 Effectiveness of an air cooled vest using selected air

temperature, humidity and air flow rate, combinations [AD-A183298] p 326 N87-30071 ARRAYS

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex p 305 N87-30023 [AD-A183204]

Circulatory changes in carotid artery basin in response

to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

ASSESSMENTS

The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054

Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069 ATMOSPHERIC COMPOSITION

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory p 306 A87-50950 system **ATROPHY** 

A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle Studies with RU 38486, a potent and selective antiglucocorticoid p 296 A87-51151

Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility

[NASA-CR-181344] p 303 N87-29077 ATTENTION

Method of enhancing interference resistance of operator performance p 317 N87-29098

ATTITUDE (INCLINATION) Review of Potegal book on spatial abilities of man

p 317 N87-29106 ATTITUDE INDICATORS

Tracking a laser-projected horizon indicator [AD-A183384] p 318 N87-30051 AUDITORY PERCEPTION

Levels of analysis of complex auditory stimuli p 311 N87-29110 [AD-A182699]

**AUDITORY STIMULI** Levels of analysis of complex auditory stimuli

[AD-A182699] p 311 N87-29110 AUGMENTATION

Enhancement of human performance in manual target acquisition and tracking

[AD-A183549] p 318 N87-30053 **AUTOMATIC CONTROL** 

Automated analysis of vectorcardiograms in space medicine nedicine p 310 N87-29099 Automated Subsystem Control for Life Support System (ASCLSS)

INASA-CR-1720031 p 321 N87-29117 Automation at the man-machine interface

p 322 N87-29504 AVIATION PSYCHOLOGY

Evaluation of psychological fitness for flight work p 310 N87-29104

В

# BACTERIA

Bacterial activity in the warmer, sulphate-bearing, p 296 A87-51251 Archaean oceans metabolism of a thermoacidophilic Energy archaebacterium, Sulfolobus acidocaldarius

p 303 A87-53841 Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate

p 305 N87-29103

**BIBLIOGRAPHIES** Aerospace medicine and biology: / bibliography with indexes (supplement 302) continuing [NASA-SP-7011(302)] p 314 N87-30041 Naval Aerospace Medical Research Laboratory

bibliography, 1981-1986 [AD-A183837] p 315 N87-30048

**BINOCULAR VISION** 

Parallel processing of motion and colour information p 316 A87-54099 **BIOASTRONAUTICS** 

Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary

p 299 A87-52988 Survey of the vestibulum, and behavior of Xenopus laevis larvae developed during a 7-days space flight

p 300 A87-52996 Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985) p 300 A87-52997

Effects of rectilinear acceleration, caloric and optokinetic stimulation of human subjects in the Spacelab D-1 mission p 308 A87-52998

Subjective vertical before and after space flight p 308 A87-52999

JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March April 1987

(JPRS-USB-87-004) p 309 N87-29080 BIOCHEMISTRY

Species variation in lung antioxidant enzyme activities p 296 A87-52217

the stability of p 327 A87-53008 Physical-chemical limits biomolecules Molecular aspects of adaptation to extreme cold p 327 A87-53009

Microbial life at extremely low nutrient levels p 300 A87-53012 Survival strategies of microorganisms in extreme saline p 300 A87-53013 environments

Survival under space vacuum - Biochemical aspects p 327 A87-53014 An enzyme immunoassay for rat growth hormone -

Applications to the study of growth hormone variants p 302 Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 microscopy

USSR Report: Life Sciences. Biomedical and behavioral sciences [JPRS-UBB-87-009] p 314 N87-30042

BIODYNAMICS

Concept of functional strength in the problem of objectivization of biomechanical specifications for protective and rescue gear for aircraft crews

p 321 N87-29084 Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 BIOELECTRICITY

Possible effects of organelle charge and density on cell metabolism --- chemical response to gravitational p 298 A87-52983 RFR research projections for the future

p 312 N87-30031

BIOLOGICAL EFFECTS

Formation of single-strand breaks in DNA under the effect of high-intensity UV radiation p 295 A87-51125 Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cells

p 301 A87-53537 Biological effectiveness of helium ions and protons of relativistic energies p 301 A87-53539 Work performance evaluation using the exercising rat

model [DE87-0101311 p 303 N87-29078 Biological effects of millimeter-wave irradiation

[AD-A182890] p 305 N87-30022 Afferent mechanisms of microwave-induced biological effects

[AD-A183562] p 305 N87-30024 Proceedings of a Workshop on Radiofrequency Radiation Bioeffects

[AD-A157090] p 312 N87-30026 Physical interactions of radiofrequency radiation fields nd biological systems p 312 N87-30027 and biological systems Critical review of selected topics on biological effects

of radiofrequency radiation p 312 N87-30029 Radiofrequency radiation safety standards

p 312 N87-30030 RFR research projections for the future

p 312 N87-30031 The cumulative effects of long-term exposure to low levels of radiofrequency radiation (RFR)

p 312 N87-30032 Human exposures to radiofrequency radiation (RFR). A p 312 N87-30033 review of RFR accidents p 312
Application of human whole-body RF absorption measurements to RFR safety standards

p 313 N87-30034 Evaluation of human exposure to low frequency fields p 313 N87-30037

Aerospace medicine and biology: Α bibliography with indexes (supplement 302) [NASA-SP-7011(302)] p 314 N87-30041 BIOLOGICAL EVOLUTION

Comparative characterization of the sleep-wakefulness cycle in hibernating and nonhibernating mammals p 296 A87-51673

The origin and evolution and comparative physiology of gravity sensing organs p 298 Hypotheses on the appearance of life on earth (Review) p 326 A87-53000 Exobiology revisited p 326 A87-53001 Survey of earth orbital telescopes and their potential rexobiology p 327 A87-53005 for exobiology the stability of p 327 A87-53008 Physical-chemical limits for biomolecules Exobiology and future Mars missions - The search for p 327 A87-53011

Mars' earliest biosphere Survival strategies of microorganisms in extreme saline environments p 300 A87-53013

Clay minerals and the origin of life --- Book p 327 A87-53551 1986 ISSOL Meeting, 5th, Berkeley, CA, July 21-25,

1986, Proceedings p 328 A87-53826 Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828 Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in the primitive ocean p 303 A87-53830 Liposomes with polyribonucleotides as model of p 328 A87-53835 precellular systems Selective emergence and survival of early polypeptides

p 329 A87-53839 Search for catalytic properties of simple polypeptides p 329 A87-53840

metabolism of a thermoacidophilic archaebacterium, Sulfolobus acidocaldarius p 303 A87-53841

Origin and evolution of photosynthetic p 303 A87-53843 centers

Structural elements and organization of the ancestral translational machinery p 3
BIOLOGICAL MODELS (MATHEMATICS) p 330 A87-53844

The development of an algorithm for predicting the success of an operator's activity on the basis of a small learning sample p 315 A87-50947

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165 p 306 A87-52087

Cone sampling array models Systems interrelations of gravity responses in the human organism, and the use of modelling p 308 A87-53015 The use of individual differences in inferring human operator intentions

p 320 A87-53063 Work performance evaluation using the exercising rat

[DE87-0101311 p 303 N87-29078 Specific absorption rate distributions in a heterogeneous model of the human body at radiofrequencies p 313 N87-30040 [PB87-2013561

Interaction of macula and semicircular canals in angular stabilization of man in space p 314 N87-30045

BIOMEDICAL DATA Algorithm

and software program of an information/measurement system for evaluating the state p 319 A87-52830 of an operator BIOPHYSICS

Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 RFR research projections for the future p 312 N87-30031

Evaluation of human exposure to low frequency fields p 313 N87-30037 USSR Report: Life Sciences, Biomedical and behavioral

sciences [JPRS-UBB-87-009] p 314 N87-30042

BIOSPHERE Exobiology and future Mars missions - The search for

Mars' earliest biosphere p 327 A87-53011 Biosphere II - The closed ecology project

[AAS PAPER 86-119] p 320 A87-53092 The closed ecology project - Agricultural and life sciences background IAAS PAPER 86-1201 p 320 A87-53093

1986 ISSOL Meeting, 5th, Berkeley, CA, July 21-25, 1986, Proceedings p 328 A87-53826 BIOSYNTHESIS

The relationship between the biosynthetic paths to the amino acids and their coding. I - The aliphatic amino acids p 329 A87-53842 and proline Structural elements and organization of the ancestral translational machinery

p 330 A87-53844 Information theory and the genetic code p 330 A87-53845

# BLINKING

Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system p 324 N87-30061 displays

COSMIC RAYS SUBJECT INDEX

Work performance evaluation using the exercising rat model

[DE87-010131] p 303 N87-29078 Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for 6

vears p 304 N87-29095

# **BLOOD CIRCULATION**

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085 Dynamics of fluid turnover in human extremities as related to different body positions p 309 N87-29088 Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309

Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest

p 314 N87-30043

# RLOOD PRESSURE

Dynamics of fluid turnover in human extremities as p 309 N87-29088 ated to different body positions RI OOD VESSEI S

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085 Adaptive and cumulative effects on dogs of regular N87-29087 exposure to +Gz accelerations p 304 Dynamics of fluid turnover in human extremities as related to different body positions p 309 N87-29088 Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309 N87-29090

### **BODY KINEMATICS**

Concept of functional strength in the problem of objectivization of biomechanical specifications for protective and rescue gear for aircraft crews p 321 N87-29084

Mathematical model of pilot head kinematics during p 321 N87-29097 eiection into air flow BODY TEMPERATURE

Thermal physiology of RFR interactions in animals and p 312 N87-30028 Adjustment and validation of the mathematical prediction

model for sweat rate, heart rate and body temperature under outdoor conditions

[AD-A183109] p 314 N87-30046

# **BONE DEMINERALIZATION**

The effect of microgravity on plasma-osteocalcin p 308 A87-52994

# **BONE MARROW**

Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying p 304 N87-29101

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 microscopy

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204]

p 305 N87-30023 Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036 Naval Aerospace Medical Research Laboratory

bibliography, 1981-1986 [AD-A183837] p 315 N87-30048

# **BREATHING APPARATUS**

Incompatibility of the M-1 maneuver with US Navy tactical aircraft oxygen systems [AD-A183731] p 326 N87-30072

# CALCIUM

Role of calcium in gravity perception of plant roots

p 298 A87-52985 Distribution of calmodulin in corn seedlings -Immunocytochemical localization in coleoptiles and root p 299 A87-52986

# CARBOHYDRATE METABOLISM

Symposium on space gastroenterology p 310 N87-29105

# The formation of amino acid precursors in the reaction

of atomic carbon with water and ammonia at 77 K p 328 A87-53831

# CARBON DIOXIDE CONCENTRATION

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory system CARDIOLOGY p 306 A87-50950

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory p 306 A87-50950

# CARDIOVASCULAR SYSTEM

Hysteresis in response to descending and ascending lower-body negative pressure p 308 A87-52221 Functional state of the human cardiorespiratory system following 30-day antiorthostatic hypokinesia

p 309 N87-29089

# CAROTID SINUS BODY

Carotid body contributions to the exercise hypernea in p 311 N87-29113 man Circulatory changes in carotid artery basin in response

to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

# CAROTID SINUS REFLEX

Time-dependent effect of hypoxia on carotid body chemosensory function nemosensory function p 297 A87-52220 Carotid body contributions to the exercise hypernea in p 311 N87-29113

# CATALYTIC ACTIVITY

Search for catalytic properties of simple polypeptides p 329 A87-53840 A small catalytic oligoribonucleotide

p 303 A87-54091

# CELLS (BIOLOGY)

Physical parameters affecting living cells in space p 297 A87-52977 Classification of gravity effects on 'free' cells

p 297 A87-52978 Effects of gravity perturbation on developing animal systems p 298 A87-52980

Possible effects of organelle charge and density on cell metabolism --- chemical response to gravitational stimulus p 298 A87-52983 Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949)

p 302 A87-53629 Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and perpendicular light scatter p 302 A87-53649 Liposomes with polyribonucleotides as model of

p 328 A87-53835 precellular systems Selective emergence and survival of early polypeptides water p 329 A87-53839

### CEREBRAL CORTEX

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization ress p 295 A87-51106 The dependence of the vestibular reactions of cat stress

cortical neurons on the duration and direction of sinusoidal p 295 A87-51109 rotation

Review of Potegal book on spatial abilities of man p 317 N87-29106

# CHEMICAL COMPOSITION

Work performance evaluation using the exercising rat model [DE87-010131] p 303 N87-29078

# CHEMICAL EVOLUTION

Radiation stability of organic matter in liquid and frozen H2O. NH3 and water-ammonia mixtures

p 326 A87-53003 Search for organic molecules in the outer solar p 327 A87-53007

Studies on the structure of HCN oligomers

p 328 A87-53832 Prebiotic synthesis of imidazole-4-acetaldehyde and histidine p 328 A87-53833

Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates

p 328 A87-53834 template Kinetic analysis of the effect in ribooligoguanylate elongation p 329 A87-53836 Binding of DNA hairpins to an assembler-strand as part p 329 A87-53838 of a primordial translation device

# **CHEMICAL REACTIONS**

A small catalytic oligoribonucleotide

p 303 A87-54091

# CHEMORECEPTORS

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization stress p 295 A87-51106

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of rats to high altitude p 295 A87-51107

Time-dependent effect of hypoxia on carotid body chemosensory function p 297 A87-52220 Biochemical reception and ionizing irradiation of an organism p 301 A87-53536

# CHIPS (ELECTRONICS)

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023

# CHLOROPHYLLS

Origin and evolution of photosynthetic reaction centers p 303 A87-53843

Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates

p 328 A87-53834

### CIRCADIAN RHYTHMS

Naval Aerospace

Comparative characterization of the sleep-wakefulness cycle in hibernating and nonhibernating mammals

p 296 A87-51673 Medical Research Laboratory

bibliography, 1981-1986 [AD-A183837] p 315 N87-30048

# CIRCUITS

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023

# CLAYS

Clay minerals and the origin of life --- Book p 327 A87-53551

**CLOSED ECOLOGICAL SYSTEMS** 

Biosphere II - The closed ecology project

[AAS PAPER 86-119] p 320 A87-53092 The closed ecology project - Agricultural and life

sciences background [AAS PAPER 86-120] p 320 A87-53093

# COCKPITS

Organization of displays in the visual space of the combat p 322 N87-29516 aircraft pilot

# COGNITION

Sophisticated integral control methods for use in flight Spatial ability as a predictor of flight training performance

AD-A183141] p 318 N87-30050

### COLD ACCLIMATIZATION

The effect of adaptation to cold and of short-term exposure to cold on the resistance of animals to hypoxic hypoxia p 295 A87-51108 Molecular aspects of adaptation to extreme cold environments p 327 A87-53009

# **COLOR VISION**

Interaction between colour and motion in human p 316 A87-54098 Parallel processing of motion and colour information

p 316 A87-54099

# COMPUTER PROGRAMS

Exposure to radiofrequency fields in the Netherlands: p 313 N87-30035 Measurements and evaluation COMPUTER TECHNIQUES

Closing the man-machine loop: On the use of physiological measures to affect computer-controlled p 322 N87-29507 devices

# CONDENSING

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensa p 305 N87-29103

Life sciences and space research XXII(2); Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July 1, 1986 p 297 A87-52976 1986 ISSOL Meeting, 5th, Berkeley, CA, July 21-25, 286, Proceedings p 328 A87-53826 11, 1986 1986, Proceedings p 328 A87-53826 Proceedings of a Workshop on Radiofrequency

Radiation Bioeffects [AD-A157090] p 312 N87-30026

# CONTRAST

Contrast discrimination in peripheral vision

p 307 A87-52093

CONTROL THEORY Taking account of rules in the prediction of the possible p 319 A87-52829 strategies of active partners
CONTROLLABILITY

Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067

# CORN

Distribution of calmodulin in corn seedlings -Immunocytochemical localization in coleoptiles and root p 299 A87-52986 Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985)

# CORTICOSTEROIDS

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization p 295 A87-51106 stress

A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle
- Studies with RU 38486, a potent and selective
antiglucocorticoid p 296 A87-51151

# COSMIC RAYS

Embryogenesis and organogenesis of Carausius morosus under spaceflight conditions

p 299 A87-52991

p 300 A87-52997

Genetic and physiological damage induced by cosmic radiation on dry plant seeds during space flight

p 299 A87-52993

Automated analysis of vectorcardiograms in space p 310 N87-29099 medicine

COSMOS SATELLITES

Investigations onboard the biosatellite Cosmos-1667 p 299 A87-52989

**CREW PROCEDURES (INFLIGHT)** 

Use of task timeline analysis to assess crew workload p 323 N87-30056 Flight test evaluation of crew workload. Part 1: Aircraft

certification for a minimum crew of two pilots

p 324 N87-30063 Measurement of aircrew workload during low-level flight. Part 1: A comparison between in-flight and post flight p 325 N87-30064 assessment methods

Measurement of pilot workload p 325 N87-30068 Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations AD-A1832981 p 326 N87-30071

CRITICAL FLICKER FUSION

Some characteristics of peripheral vision

p 306 A87-51178 CROP GROWTH

Interaction of growth-determining systems with gravity p 299 A87-52987

Role of orientation reference selection in motion

sickness, supplement 2S [NASA-CR-181393] p 315 N87-30049

CULTURE TECHNIQUES

Biological effects of millimeter-wave irradiation

[AD-A1828901 p 305 N87-30022 Growth factor involvement in tension-induced skeletal

muscle growth [NASA-CR-181349] p 311 N87-30025

CUMULATIVE DAMAGE

The cumulative effects of long-term exposure to low levels of radiofrequency radiation (RFR)

p 312 N87-30032

**CURRENT DENSITY** 

Evaluation of human exposure to low frequency fields p 313 N87-30037

CYTOCHROMES

CYTOLOGY

metabolism of thermoacidophilic Energy archaebacterium, Sulfolobus acidocaldarius

p 303 A87-53841

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization p 295 A87-51106

Formation of single-strand breaks in DNA under the effect of high-intensity UV radiation p 295 A87-51125 Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985)

p 300 A87-52997 Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cells

p 301 A87-53537 Flow cytometric immunofluorescence of rat anterior p 302 A87-53619

Execution of 'ARC' experiment on Space Shuttle 'Discovery' STS 51-C - Some results on aggregation of red blood cells under zero gravity --- Aggregation of Red p 309 A87-53620

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624

Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and perpendicular light scatter p 302 A87-53649

Flow cytometric analysis and sorting of live female rat anterior pituitary cell types by forward angle and perpendicular light scatter - Effect of 17 beta-estradiol p 302 A87-53650

CYTOPLASM

Amphibian egg cytoplasm response to altered g-forces p 297 A87-52979 and gravity orientation

Survival strategies of microorganisms in extreme saline environments p 300 A87-53013

D

DATA ACQUISITION

Specific absorption rate distributions in a heterogeneous model of the human body at radiofrequencies p 313 N87-30040 [PB87-201356]

DATA PROCESSING

Automated analysis of vectorcardiograms in space medicine p 310 N87-29099

DATA SAMPLING

The development of an algorithm for predicting the success of an operator's activity on the basis of a small p 315 A87-50947 learning sample p 306 A87-52087 Cone sampling array models

DEATH

Investigation of the mechanism of thymocyte death under ultrahigh gamma-ray doses p 301 A87-53538

DECISION MAKING

Closing the man-machine loop: On the use of physiological measures to affect computer-controlled p 322 N87-29507

DECOMPRESSION SICKNESS

Empirical models for use in designing decompression procedures for space operations

[NASA-TM-100456] DEOXYRIBONUCLEIC ACID

Formation of single-strand breaks in DNA under the effect of high-intensity UV radiation p 295 A87-51125 Binding of DNA hairpins to an assembler-strand as part of a primordial translation device p 329 A87-53838

DIELECTRIC PROPERTIES

Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036 DIPHOSPHATES

Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates

p 328 A87-53834

Alcohol, emotions, stress and performance p 316 N87-29083

Treatment of degenerative diseases of the spine by physiotherapy DRIC-T-76131 p 310 N87-29108

DISORIENTATION

Spatial orientation in flight [AD-A183431] p 314 N87-30047

DISPLAY DEVICES

The simulation of flexible activity algorithms (For the example of an operator-display system)

p 319 A87-52831 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508

Organization of displays in the visual space of the combat p 322 N87-29516

Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system p 324 N87-30061 displays

DISRUPTING

Method of enhancing interference resistance of operator p 317 N87-29098 performance DOGS

Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087

Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for 6 p 304 N87-29095

DOSIMETERS

Dosimetric mapping inside Biorack

p 320 A87-52990 Physical interactions of radiofrequency radiation fields nd biological systems p 312 N87-30027 and biological systems

DRUGS

Status of Alpha 1-adrenergic regulation of stroke volume in hypokinetic rats p 304 N87-29091

DYNAMIC CONTROL

The human strategies in the formation of subjective constraints on manual-control parameters

p 319 A87-52828

Ε

EARTH (PLANET)

Hypotheses on the appearance of life on earth (Review) p 326 A87-53000 EARTH ORBITAL ENVIRONMENTS

Survey of earth orbital telescopes and their potential for exobiology p 327 A87-53005 EFFECTIVENESS

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations [AD-A183298] p 326 N87-30071

**EFFERENT NERVOUS SYSTEMS** 

Hypoxia and monosynaptic reflexes in humans p 307 A87-52219

Amphibian egg cytoplasm response to altered g-forces p 297 A87-52979 and gravity orientation

**EJECTION SEATS** 

Mathematical model of pilot head kinematics during ejection into air flow ELECTRIC CHARGE

Charging of a man in the wake of the shuttle

**ELECTRIC FIELDS** 

[AD-A182789] p 311 N87-29111

Physical interactions of radiofrequency radiation fields and biological systems p 312 N87-30027

Evaluation of human exposure to low frequency fields p 313 N87-30037

Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77)
p 313 N87-30039

ELECTRIC POTENTIAL

Charging of a man in the wake of the shuttle p 311 N87-29111

ELECTROCARDIOGRAPHY

Naval Aerospace Medical Research Laboratory bibliography, 1981-1986 [AD-A183837]

p 315 N87-30048 ELECTROMAGNETIC FIELDS

RFR research projections for the future

p 312 N87-30031 Radiofrequency radiation safety guidelines in the Federal

Republic of Germany
ELECTRON SCATTERING p 313 N87-30038

Charging of a man in the wake of the shuttle [AD-A182789] p 311 N87-29111

EMBRYOS

Embryogenesis and organogenesis of Carausius morosus under spaceflight conditions

p 299 A87-52991 Survey of the vestibulum, and behavior of Xenopus laevis larvae developed during a 7-days space flight

p 300 A87-52996

Alcohol, emotions, stress and performance p 316 N87-29083

END EFFECTORS

Robot manipulators for sample handling in space

p 320 A87-53921

**ENDOCRINOLOGY** Flow cytometric immunofluorescence of rat anterior

pituitary cells p 302 A87-53619 Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949)

p 302 A87-53629 Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and perpendicular light scatter p 302 A87-53649

ENVIRONMENTAL CONTROL

The closed ecology project - Agricultural and life sciences background

AAS PAPER 86-1201 p 320 A87-53093 **ENVIRONMENTAL ENGINEERING** 

The closed ecology project - Agricultural and life sciences background

IAAS PAPER 86-120] p 320 A87-53093 **ENZYME ACTIVITY** 

Species variation in lung antioxidant enzyme activities p 296 A87-52217 Peroxidation of lipids and the concentration of alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression

p 301 A87-53535 An enzyme immunoassay for rat growth hormone -

Applications to the study of growth hormone variants p 302 A87-53615 Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron microscopy p 302 A87-53624 ENZYMES

Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates

p 328 A87-53834 **EPIDEMIOLOGY** 

USSR Report: Life Sciences. Biomedical and behavioral p 314 N87-30042

[JPRS-UBB-87-009] ERROR ANALYSIS

A study of pilot flight information crossmonitoring performance p 322 N87-29509

ERRORS

Hesitations in continuous tracking induced by a concurrent discrete task p 315 A87-51164

ERYTHROCYTES

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of p 295 A87-51107 rats to high altitude

Execution of 'ARC' experiment on Space Shuttle 'Discovery' STS 51-C - Some results on aggregation of red blood cells under zero gravity --- Aggregation of Red blood Cells p 309 A87-53620

OUD ISOT INDEX		
SUBJECT INDEX		
ESTROGENS		
Flow cytometric analysis and sorting		
anterior pituitary cell types by f		
perpendicular light scatter - Effect of		
	p 302	A87-53650
EUKARYOTES		
Biochemical reception and ionizing		
organism		A87-53536
EVOKED RESPONSE (PSYCHOPHYSI		
Hesitations in continuous tracki concurrent discrete task		ысео by а A87-51164
••••••		
Cortical evoked response and eyeb		
workload evaluation of alternative displays		ing system N87-30061
EXERCISE PHYSIOLOGY	p 324	1407-30001
Functional state of the human card	oreenire	ton evetem
following 30-day antiorthostatic hypol	rinesia	itory system
ionorming to day amerimodate rijpor	p 309	N87-29089
Distinctions of psychosomatic corre		
		N87-29093
EXOBIOLOGY	•	
Life sciences and space research	(XII(2): I	Proceedinas
of the Topical Meeting and Work	shop 4	of the 26th
COSPAR Plenary Meeting, Toulouse, F	rance,	June 30-July
11, 1986	p 297	A87-52976
Physical parameters affecting living		
		A87-52977
Classification of gravity effects on '		
	p 297	A87-52978
Effects of gravity perturbation on		
systems		A87-52980
Geotropic sensitivity exhibited by s		
influence of caste, age, light and tem		
	p 298	A87-52981
Interaction of growth-determining sy		
		A87-52987
Bioscience experiments in the		i Spacelab
mission D-1 - Introduction and summa		407 50000
A contract of the late of the	•	A87-52988
Investigations onboard the biosatel		A87-52989
F	F	
Embryogenesis and organogene morosus under spaceflight conditions		Carausius
moroada unider apacemigni conditions		A87-52991
Genetic and physiological damage		
radiation on dry plant seeds during sp		
The state of the s		A87-52993

Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness p 300 A87-52995 Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985) p 300 A87-52997 Exobiology revisited p 326 A87-53001 Space Station gas-grain simulation facility - Application p 326 A87-53002 Survey of earth orbital telescopes and their potential

to exobiology p 327 A87-53005 for exobiology Physical-chemical limits for the stability of p 327 A87-53008 biomolecules Molecular aspects of adaptation to extreme cold p 327 Exobiology and future Mars missions - The search for p 327 A87-53011 Mars' earliest biosphere Survival under space vacuum - Biochemical aspects p 327 A87-53014 Clay minerals and the origin of life --- Book p 327 A87-53551 USSR Space Life Sciences Digest, issue 13 [NASA-CR-3922(15)] p 304 N87-29079 JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March p 309 N87-29080 [JPRS-USB-87-0041 Aerospace medicine and biology: A continuing bibliography with indexes (supplement 302)
[NASA-SP-7011(302)] p 314 p 314 N87-30041 EXPERT SYSTEMS

The task taxonomy method: A basis for an expert system p 318 N87-29506 on human reliability **EXPOSURE** 

Investigation of critical fusion frequency in man during p 317 N87-29094 exposure to noise EXTRATERRESTRIAL LIFE

Exobiology revisited p 326 A87-53001 Radiation stability of organic matter in liquid and frozen H2O, NH3 and water-ammonia mixtures

p 326 A87-53003 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010

# **EXTRAVEHICULAR ACTIVITY**

Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114

EYE DI	SE/	ASES	ì
--------	-----	------	---

Does cone positional disorder limit resolution? p 306 A87-52086 Cone sampling array models p 306 A87-52087

EYE DOMINANCE Parallel processing of motion and colour information

# EYE MOVEMENTS

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment [DFVLR-FB-86-61] p 317 N87-29115

p 316 A87-54099

# FATIGUE (BIOLOGY)

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations [AD-A183298] p 326 N87-30071 [AD-A183298]

# FEEDBACK CONTROL

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165

# FIELD OF VIEW

In-flight assessment of workload using instrument can p 324 N87-30062

# FLIGHT CONTROL

Sophisticated integral control methods for use in flight p 322 N87-29510

# FLIGHT CREWS

Concept of functional strength in the problem of specifications for objectivization of biomechanical protective and rescue gear for aircraft crews

p 321 N87-29084 Measurement of aircrew workload during low-level flight. Part 1: A comparison between in-flight and post flight assessment methods p 325 N87-30064

# FLIGHT INSTRUMENTS

In-flight assessment of workload using instrument p 324 N87-30062

# **FLIGHT OPERATIONS**

The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506 A study of pilot flight information crossmonitoring performance p 322 N87-29509 Sophisticated integral control methods for use in flight p 322 N87-29510

In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055 The use of subjective workload assessment technique

in a complex flight task p 324 N87-30058 Workload methodology p 324 N87-30059

Mental workload measurement in operational aircraft systems: Two promising approaches

p 318 N87-30060 Cortical evoked response and eveblink measures in the workload evaluation of alternative landing system p 324 N87-30061 displays

In-flight assessment of workload using instrument p 324 N87-30062 scan

Measurement of aircrew workload during low-level flight. Part 1: A comparison between in-flight and post flight p 325 N87-30064 assessment methods In-flight assessment of workload using pilot ratings and heart rate p 315 N87-30065

The assessment of workload in helicopters p 325 N87-30066

# FLIGHT SIMULATION

USSR Space Life Sciences Digest, issue 13 [NASA-CR-3922(15)] p 304 N87-29079 Flight simulation motion-base drive algorithms. Part 3:

### p 317 N87-29116 [UTIAS-319]

# FLIGHT SIMULATORS

Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162

Flight simulation motion-base drive algorithms. Part 3: Pilot evaluations (UTIAS-319) p 317 N87-29116

# FLIGHT STRESS (BIOLOGY)

Psychological control of health status during long-term exposure to longitudinal accelerations p 317 N87-29107

# FLIGHT TEST INSTRUMENTS

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment [DFVLR-FB-86-61] p 31

# p 317 N87-29115

# FLIGHT TESTS

Pilot subjective evaluation of workload during a flight p 324 N87-30057 test certification programme Flight test evaluation of crew workload. Part 1: Aircraft certification for a minimum crew of two pilots

p 324 N87-30063

### FLIGHT TRAINING

Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053

# FLUX DENSITY

Exposure to radiofrequency fields in the Netherlands: Measurements and evaluation p 313 N87-30035

# FOCUSING

Improving visual performance through volitional focus p 306 A87-51163 control Accommodation to stimuli in peripheral vision

p 307 A87-52095

### **FORMALDEHYDE**

Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in p 303 A87-53830 the primitive ocean

# FOSSILS

The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010

# **FOVEA**

Does cone positional disorder limit resolution?

p 306 A87-52086 p 306 A87-52087 Cone sampling array models Peripheral hyperacuity - Isoeccentric bisection is better p 307 A87-52090 than radial bisection FRFF7ING

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103

# **FREQUENCIES**

Biological effects of millimeter-wave irradiation

p 305 N87-30022 [AD-A182890] Exposure to radiofrequency fields in the Netherlands: p 313 N87-30035 Measurements and evaluation **FUNCTIONAL ANALYSIS** 

Optimization of peripheral vision

[AD-A182438] p 310 N87-29109 **FUZZY SETS** 

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165

# G

# **GAMMA RAYS**

Investigation of the mechanism of thymocyte death under ultrahigh gamma-ray doses p 301 A87-53538 Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for 6 p 304 N87-29095 GASES

A simulation model for the analysis of Space Station p 321 A87-53979 gas-phase trace contaminants Work performance evaluation using the exercising rat model IDF87-0101311 p 303 N87-29078

GASTROINTESTINAL SYSTEM

# Symposium on space gastroenterology

p 310 N87-29105 **GENETIC CODE** 

# The relationship between the biosynthetic paths to the

amino acids and their coding. I - The aliphatic amino acids p 329 A87-53842 Information theory and the genetic code

p 330 A87-53845

Formation of single-strand breaks in DNA under the effect of high-intensity UV radiation p 295 A87-51125 Genetic and physiological damage induced by cosmic radiation on dry plant seeds during space flight

p 299 A87-52993 USSR Report: Life Sciences. Biomedical and behavioral sciences

[JPRS-UBB-87-009] p 314 N87-30042

# GEOCHEMISTRY

Possible biological origin of banded iron-formations from p 302 A87-53828 hydrothermal solutions GEÓTEMPERATURE

Possible biological origin of banded iron-formations from p 302 A87-53828 hydrothermal solutions GEÓTROPISM

Geotropic sensitivity exhibited by single hornets - The influence of caste, age, light and temperature

p 298 A87-52981

# **GLOMERULUS**

Head-down tilt and restraint on renal function and p 296 A87-52215 glomerular dynamics in the rat GLUCOSE

Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates

p 328 A87-53834

GRATINGS (SPECTRA)

Spatiotemporal properties of grating motion detection in the center and the periphery of the visual field p 307 A87-52094

**GRAVIRECEPTORS** 

Relevance Polarity of root statocytes p 298 A87-52984

GRAVITATIONAL EFFECTS

Life sciences and space research XXII(2); Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July 11, 1986 n 297 A87-52976 Classification of gravity effects on 'free' cells

p 297 A87-52978 Effects of gravity perturbation on developing animal p 298 A87-52980 systems

Geotropic sensitivity exhibited by single hornets - The influence of caste, age, light and temperature p 298 A87-52981

Role of calcium in gravity perception of plant roots p 298 A87-52985

**GRAVITATIONAL PHYSIOLOGY** 

The dependence of the vestibular reactions of cat cortical neurons on the duration and direction of sinusoidal p 295 Physical parameters affecting living cells in space

p 297 A87-52977

Effects of gravity perturbation on developing animal p 298 A87-52980 The origin and evolution and comparative physiology

p 298 A87-5298 of gravity sensing organs Possible effects of organelle charge and density on cell

metabolism --- chemical response to gravitational p 298 Interaction of growth-determining systems with gravity

p 299 A87-52987 Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary

p 299 A87-52988 Embryogenesis and organogenesis of morosus under spaceflight conditions

p 299 A87-52991 Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness

p 300 A87-52995 Survey of the vestibulum, and behavior of Xenopus laevis larvae developed during a 7-days space flight

p 300 A87-52996 Subjective vertical before and after space flight

p 308 A87-52999 Systems interrelations of gravity responses in the human organism, and the use of modelling p 308 A87-53015 The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights

n 308 A87-53016

GRAVITROPISM

Distribution of calmodulin in corn seedlings Immunocytochemical localization in coleoptiles and root D 299

GROWTH Effects of gravity perturbation on developing animal p 298 systems

An enzyme immunoassay for rat growth hormone -Applications to the study of growth hormone variants p 302 A87-53615

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949) p 302 A87-53629

Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility

[NASA-CR-181344] p 303 N87-29077 Growth factor involvement in tension-induced skeletal muscle growth

[NASA-CR-181349] p 311 N87-30025

GYROSTABILIZERS

Tracking a laser-projected horizon indicator p 318 N87-30051 [AD-A183384]

Radiofrequency radiation safety guidelines in the Federal Republic of Germany p 313 N87-30038 HAZE

Space Station gas-grain simulation facility - Application p 326 A87-53002 to exobiology HEAD DOWN TILT

Head-down tilt and restraint on renal function and glomerular dynamics in the rat p 296 A87-52215 HEAD MOVEMENT

Mathematical model of pilot head kinematics during p 321 N87-29097 ejection into air flow

HEALTH

Medical problems associated with long-duration space flights

[AAS PAPER 86-115] p 308 A87-53090 HEALTH PHYSICS

Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying p 304 N87-29101

Proceedings of a Workshop on Radiofrequency Radiation Bioeffects

[AD-A1570901 n 312 N87-30026 Radiofrequency radiation safety standards

p 312 N87-30030 Exposure to radiofrequency fields in the Netherlands: p 313 N87-30035 Measurements and evaluation Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77)

p 313 N87-30039

HEARING Naval Aerospace Medical Research Laboratory bibliography, 1981-1986

[AD-A183837] p 315 N87-30048 Adaptability of the rat hypokinetic heart to afterload, and

the role of nervous regulation p 304 N87-29092

JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March

[JPRS-USB-87-004] p 309 N87-29080 Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309 N87-29090 Status of Alpha 1-adrenergic regulation of stroke volume p 304 N87-29091 in hypokinetic rats Adaptability of the rat hypokinetic heart to afterload, and the role of nervous regulation n 304 N87-29092 Automated analysis of vectorcardiograms in space

p 310 N87-29099 Effect of voluntary control of respiration on functional state of the cardiorespiratory system in the presence of p 310 N87-29102 hypoxic hypoxia

HEART RATE

Changes in the cardiac rhythm and its regulation during acute exposure to heat p 300 A87-53533 Adjustment and validation of the mathematical prediction

model for sweat rate, heart rate and body temperature under outdoor conditions [AD-A183109] p 314 N87-30046 In-flight assessment of workload using pilot ratings and

heart rate HEAT TRANSFER

Thermal physiology of RFR interactions in animals and p 312 N87-30028 humans

p 315 N87-30065

HELICOPTER PERFORMANCE

The assessment of workload in helicopters p 325 N87-30066

HELICOPTERS

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment

[DFVLR-FB-86-61] p 317 N87-29115 HÈLIUM IONS

Biological effectiveness of helium ions and protons of relativistic energies p 301 A87-53539 HEMATOLOGY

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of p 295 A87-51107 rats to high altitude p 295 A87-51107
Execution of 'ARC' experiment on Space Shuttle

'Discovery' STS 51-C - Some results on aggregation of red blood cells under zero gravity --- Aggregation of Red blood Cells p 309 A87-53620

HEMODYNAMIC RESPONSES

Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

Hemodynamic effects of negative pressure in lower p 314 N87-30044 body HIBERNATION

Comparative characterization of the sleep-wakefulness cycle in hibernating and nonhibernating mammals p 296 A87-51673

HIGH ALTITUDE BREATHING

Effect of voluntary control of respiration on functional state of the cardiorespiratory system in the presence of p 310 N87-29102 hypoxic hypoxia

HIGH ENERGY ELECTRONS

Charging of a man in the wake of the shuttle [AD-A182789]

p 311 N87-29111

HISTIDINE Prebiotic synthesis of imidazole-4-acetaldehyde and

p 328 A87-53833 HISTOLOGY

An enzyme immunoassay for rat growth hormone -Applications to the study of growth hormone variants p 302 A87-53615 HORIZON

Tracking a laser-projected horizon indicator

IAD-A1833841 p 318 N87-30051

HORIZONTAL ORIENTATION

Formation of spatial position image with onset of illusions of vestibular origin n 309 N87-29082 Tracking a laser-projected horizon indicator

AD-A183384] p 318 N87-30051

HORMONE METABOLISMS

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of rats to high altitude n 295 A87-51107 Biochemical reception and ionizing irradiation of an p 301 A87-53536

An enzyme immunoassay for rat growth hormone -Applications to the study of growth hormone variants p 302 A87-53615

HORMONES

A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle Studies with RU 38486, a potent and selective p 296 A87-51151 antiglucocorticoid Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility

[NASA-CR-181344] p 303 N87-29077

**HUMAN BEHAVIOR** 

Study of anticipation mechanisms in the aeronautical p 317 N87-29505 environment

HUMAN BEINGS

Dynamics of fluid turnover in human extremities as p 309 N87-29088 related to different body positions Thermal physiology of RFR interactions in animals and p 312 N87-30028 Critical review of selected topics on biological effects of radiofrequency radiation p 312 N87-30029 Human exposures to radiofrequency radiation (RFR). A review of RFR accidents p 312 N87-30033

HUMAN BODY

Radiofrequency radiation safety standards

p 312 N87-30030 Specific absorption rate distributions in a heterogeneous model of the human body at radiofrequencies

(PB87-2013561 HUMAN CENTRÍFUGES

Psychological control of health status during long-term exposure to longitudinal accelerations

p 317 N87-29107

p 313 N87-30040

**HUMAN FACTORS ENGINEERING** 

Human capabilities in space

The human strategies in the formation of subjective constraints on manual-control parameters

p 319 A87-52828

[AAS PAPER 86-114] p 320 A87-53089 Medical problems associated with long-duration space flights

[AAS PAPER 86-115] p 308 A87-53090 Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel

p 316 N87-29081

**HUMAN PERFORMANCE** 

Optimization of peripheral vision [AD-A182438]

p 310 N87-29109 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective p 322 N87-29508 Sophisticated integral control methods for use in flight p 322 N87-29510

Enhancement of human performance in manual target acquisition and tracking p 318 N87-30053

[AD-A183549]

**HUMAN REACTIONS** The use of individual differences in inferring human operator intentions p 320 A87-53063

HYDROCYANIC ACID

Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in the primitive ocean p 303 A87-53830

Studies on the structure of HCN oligomers p 328 A87-53832

**HYDROPONICS** 

Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253 p 297 A87-52253 HYDROSTATIC PRESSURE

Physical parameters affecting living cells in space

p 297 A87-52977 **HYPERNEA** 

Carotid body contributions to the exercise hypernea in p 311 N87-29113 man HYPEROXIA

Species variation in lung antioxidant enzyme activities p 296 A87-52217

HYPERTHERMIA

The effect of high temperature on the functional condition and work capacity of an organism

p 305 A87-50948

# HYPERVENTIL ATION

Effect of voluntary control of respiration on functional state of the cardiorespiratory system in the presence of hypoxic hypoxia n 310 N87-29102

# HYPOKINESIA

JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987

p 309 N87-29080 [JPRS-USB-87-004] Functional state of the human cardiorespiratory system

following 30-day antiorthostatic hypokinesia p 309 N87-29089

Status of Alpha 1-adrenergic regulation of stroke volume in hypokinetic rats p 304 N87-29091 Adaptability of the rat hypokinetic heart to afterload, and the role of nervous regulation p 304 N87-29092 Symposium on space gastroenterology

p 310 N87-29105 Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

# **HYPOTHALAMUS**

Reaction of thermoregulatory neurons to different types of sensory stimulation p 295 A87-51110

# **HYPOXIA**

The effect of adaptation to cold and of short-term exposure to cold on the resistance of animals to hypoxic p 295 A87-51108 hypoxia Hypoxia and monosynaptic reflexes in humans

p 307 A87-52219 Time-dependent effect of hypoxia on carotid body p 297 A87-52220 chemosensory function

O2 delivery to contracting muscle during hypoxic or CO ypoxia p 297 A87-52222 Peroxidation of lipids and the concentration of hypoxia alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression

p 301 A87-53535 Effect of voluntary control of respiration on functional state of the cardiorespiratory system in the presence of p 310 N87-29102

Hysteresis in response to descending and ascending lower-body negative pressure p 308 A87-52221

# IMAGE RESOLUTION

HYSTERESIS

Cone spacing and the visual resolution limit

p 306 A87-52089 Peripheral hyperacuity - Isoeccentric bisection is better than radial bisection p 307 A87-52090 IMAGES

Formation of spatial position image with onset of illusions of vestibular origin p 309 N87-29082

# IMINES

Kinetics of the O-photointermediate bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization p 295 A87-51106

# IMMUNOASSAY

Head-down tilt and restraint on renal function and glomerular dynamics in the rat p 296 A87-52215 An enzyme immunoassay for rat growth hormone -

Applications to the study of growth hormone variants p 302 A87-53615

# IMMUNOLOGY

Flow cytometric immunofluorescence of rat anterior pituitary cells p 302 A87-53619 Immunocytochemical localization of glutamic acid

decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 USSR Report: Life Sciences. Biomedical and behavioral sciences

[JPRS-UBB-87-0091 p 314 N87-30042

# IMPACT ACCELERATION

Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086

# IMPLANTATION

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949) p 302 A87-53629

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex p 305 N87-30023 [AD-A183204]

# IN-FLIGHT MONITORING

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment [DFVLR-FB-86-61] p 317 N87-29115

### INCIDENT RADIATION

Radiofrequency radiation safety standards

p 312 N87-30030

INCOMPATIBILITY Incompatibility of the M-1 maneuver with US Navy tactical aircraft oxygen systems

[AD-A1837311 p 326 N87-30072 INFORMATION PROCESSING (BIOLOGY)

Study of anticipation mechanisms in the aeronautical

p 317 N87-29505 environment The effects of display-control I/O, compatibility, and

integrality on dual-task performance and subjective workload p 322 N87-29508 A study of pilot flight information crossmonitoring

performance p 322 N87-29509 Sophisticated integral control methods for use in flight p 322 N87-29510

Mental workload measurement in operational aircraft systems: Two promising approaches

p.318 N87-30060

Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067

# INFORMATION THEORY

Information theory and the genetic code p 330 A87-53845

# INSTRUMENT ORIENTATION

Tracking a laser-projected horizon indicator p 318 N87-30051 [AD-A183384]

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation o rats to high altitude n 295 A87-51107

### INTERFACES

INSIII IN

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex p 305 N87-30023 [AD-A183204]

# INTERPLANETARY MEDIUM

Search for organic molecules in the outer solar p 327 A87-53007

# INTERSTELLAR CHEMISTRY

The formation of amino acid precursors in the reaction of atomic carbon with water and ammonia at 77 K p 328 A87-53831

# ION DENSITY (CONCENTRATION)

Charging of a man in the wake of the shuttle p 311 N87-29111

# ION IRRADIATION

Biochemical reception and ionizing irradiation of an organism p 301 A87-53536

# **IONIZING RADIATION**

Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of p 301 A87-53540 microwave and ionizing radiation Naval Aerospace Medical Research Laboratory bibliography, 1981-1986

[AD-A183837] p 315 N87-30048

p 296 A87-51465

Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828

Dynamics of noncollagen protein metabolism in dogs

exposed to low doses of chronic gamma radiation for 6 p 304 N87-29095

Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022

Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024

# J

# JUDGMENTS

Spatial ability as a predictor of flight training performance [AD-A1831411 p 318 N87-30050

# K

JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March

[JPRS-USB-87-004] p 309 N87-29080

# L

# LANDING SIMULATION

Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162

# LASER APPLICATIONS

Flow cytometric analysis and sorting of live female rat anterior pituitary cell types by forward angle and perpendicular light scatter - Effect of 17 beta-estradiol p 302 A87-53650

Tracking a laser-projected horizon indicator p 318 N87-30051 [AD-A183384]

# LASER INDUCED FLUORESCENCE

Flow cytometric immunofluorescence of rat anterior p 302 A87-53619 pituitary cells

# LEG (ANATOMY)

Dynamics of fluid turnover in human extremities as related to different body positions p 309 N87-29088 LIFE (DURABILITY)

Biological effects of millimeter-wave irradiation

p 305 N87-30022 [AD-A182890]

# LIFE SCIENCES

USSR Space Life Sciences Digest, issue 13

[NASA-CR-3922(15)] p 304 N87-29079

# LIFE SUPPORT SYSTEMS

Automated Subsystem Control for Life Support System (ASCLSS)

[NASA-CR-172003] p 321 N87-29117

# LIGHT SCATTERING

Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and perpendicular light scatter p 302 A87-53649 Flow cytometric analysis and sorting of live female rat

anterior pituitary cell types by forward angle and perpendicular light scatter - Effect of 17 beta-estradiol p 302 A87-53650

# LINEAR ENERGY TRANSFER (LET)

Dosimetric mapping inside Biorack

p 320 A87-52990

### LIPID METAROLISM

Peroxidation of lipids and the concentration of alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression

D 301 A87-53535

Symposium on space gastroenterology p 310 N87-29105

# LIPIDS

Kinetics of the O-photointermediate bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH

p 296 A87-51465 Liposomes with polyribonucleotides as model of p 328 A87-53835 precellular systems

# LONG DURATION SPACE FLIGHT

The effect of microgravity on plasma-osteocalcin

p 308 A87-52994 The musculo-skeletal system in man - Development structure and function in dependence on gravity, and

potential limitations for long term space flights p 308 A87-53016 Medical problems associated with long-duration space

fliahts [AAS PAPER 86-115] p 308 A87-53090

LONG TERM EFFECTS The cumulative effects of long-term exposure to low levels of radiofrequency radiation (RFR) p 312 N87-30032

# LOWER BODY NEGATIVE PRESSURE

Hysteresis in response to descending and ascending lower-body negative pressure p 308 A87-52221 Hemodynamic effects of negative pressure in lower p 314 N87-30044

# LUMINANCE

Visual input requirements relating to pursuit tracking accuracy

[AD-A183445] p 318 N87-30052

# LUNGS Species variation in lung antioxidant enzyme activities

p 296 A87-52217 Adaptive and cumulative effects on dogs of regular p 304 N87-29087 exposure to +Gz accelerations

# М

# MAGNETIC FIELDS

Evaluation of human exposure to low frequency fields p 313 N87-30037

Investigation of critical fusion frequency in man during exposure to noise p 317 N87-29094 An electrical circuit model of the interface between an

### electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023

MAN ENVIRONMENT INTERACTIONS The problems of aircraft microclimate (Review of the literature) p 319 A87-50949

# MAN MACHINE SYSTEMS

MAN MACHINE SYSTEMS	Spatial ability as a predictor of flight training	MOLECULAR STRUCTURE
Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of	performance [AD-A183141] p 318 N87-30050	Studies on the structure of HCN oligomers p 328 A87-53832
information p 319 A87-52827	The practical assessment of pilot workload	Nucleic acid-like structures. II - Polynucleotide analogues
The human strategies in the formation of subjective	[AGARD-AG-282] p 323 N87-30054	as possible primitive precursors of nucleic acids
constraints on manual-control parameters	In-flight workload assessment using embedded	p 329 A87-53837
p 319 A87-52828	secondary radio communications tasks	Structural elements and organization of the ancestral translational machinery p 330 A87-53844
Taking account of rules in the prediction of the possible strategies of active partners p 319 A87-52829	p 323 N87-30055 Pilot subjective evaluation of workload during a flight	MOTION PERCEPTION
The simulation of flexible activity algorithms (For the	test certification programme p 324 N87-30057	Spatiotemporal properties of grating motion detection
example of an operator-display system)	The use of subjective workload assessment technique	in the center and the periphery of the visual field
p 319 A87-52831	in a complex flight task p 324 N87-30058	p 307 A87-52094
The use of individual differences in inferring human	Workload methodology p 324 N87-30059	Effects of rectilinear acceleration, caloric and optokinetic
operator intentions p 320 A87-53063 Automated Subsystem Control for Life Support System	Mental workload measurement in operational aircraft	stimulation of human subjects in the Spacelab D-1 mission p 308 A87-52998
(ASCLSS)	systems: Two promising approaches p 318 N87-30060	Interaction between colour and motion in human
[NASA-CR-172003] p 321 N87-29117	Cortical evoked response and eyeblink measures in the	vision p 316 A87-54098
Automation at the man-machine interface	workload evaluation of alternative landing system	Parallel processing of motion and colour information
p 322 N87-29504	displays p 324 N87-30061	p 316 A87-54099
Closing the man-machine loop: On the use of	Flight test evaluation of crew workload. Part 1: Aircraft	MOTION SICKNESS
physiological measures to affect computer-controlled devices p 322 N87-29507	certification for a minimum crew of two pilots p 324 N87-30063	Effect of vestibular stimulation on static physical work capacity p 310 N87-29100
Sophisticated integral control methods for use in flight	Assessing workload for minimum crew certification. Part	Spatial orientation in flight
p 322 N87-29510	1: Static workload analysis and performance analysis	[AD-A183431] p 314 N87-30047
Dynamic task allocation for a man-machine symbiotic	p 325 N87-30067	Naval Aerospace Medical Research Laboratory
system	METABOLISM	bibliography, 1981-1986
[DE87-011950] p 325 N87-30070 MANEUVERS	Possible effects of organelle charge and density on cell	[AD-A183837] p 315 N87-30048
Incompatibility of the M-1 maneuver with US Navy	metabolism chemical response to gravitational stimulus p 298 A87-52983	Role of orientation reference selection in motion
tactical aircraft oxygen systems	Non-enzymatic synthesis of the coenzymes, uridine	sickness, supplement 2S
[AD-A183731] p 326 N87-30072	diphosphate glucose and cytidine diphosphate choline, and	[NASA-CR-181393] p 315 N87-30049
MANIPULATORS	other phosphorylated metabolic intermediates	MOTION SIMULATION  Flight simulation motion-base drive algorithms. Part 3:
Robot manipulators for sample handling in space	p 328 A87-53834	Pilot evaluations
p 320 A87-53921 Telerobotic work system: Concept development and	Energy metabolism of a thermoacidophilic	[UTIAS-319] p 317 N87-29116
evolution p 323 N87-29866	archaebacterium, Sulfolobus acidocaldarius p 303 A87-53841	MOTION STABILITY
Traction-drive, seven-degree-of-freedom telerobot arm:	Adjustment and validation of the mathematical prediction	Interaction of macula and semicircular canals in angular
A concept for manipulation in space p 323 N87-29867	model for sweat rate, heart rate and body temperature	stabilization of man in space p 314 N87-30045
MANNED MARS MISSIONS	under outdoor conditions	MUSCLES
Medical problems associated with long-duration space	[AD-A183109] p 314 N87-30046 MICROBIOLOGY	A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle
flights [AAS PAPER 86-115] p 308 A87-53090	Microbial life at extremely low nutrient levels	- Studies with RU 38486, a potent and selective
MANNED SPACE FLIGHT	p 300 A87-53012	antiglucocorticoid p 296 A87-51151
Human capabilities in space	MICROCLIMATOLOGY	Growth hormone secretion during space flight and
[AAS PAPER 86-114] p 320 A87-53089	The problems of aircraft microclimate (Review of the	evaluation of the physiological responses of animals held
MANUAL CONTROL	literature) p 319 A87-50949	in the research animal holding facility
Hesitations in continuous tracking induced by a concurrent discrete task p 315 A87-51164	MICROORGANISMS  Microbial life at extremely low nutrient levels	[NASA-CR-181344] p 303 N87-29077 Effect of vestibular stimulation on static physical work
The human strategies in the formation of subjective	p 300 A87-53012	capacity p 310 N87-29100
constraints on manual-control parameters	Survival strategies of microorganisms in extreme saline	· ·
constraints on manual-control parameters p 319 A87-52828	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013	Growth factor involvement in tension-induced skeletal
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013 MICROPOROSITY	· ·
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013 MICROPOROSITY Porous membrane utilization in plant nutrient delivery	Growth factor involvement in tension-induced skeletal muscle growth
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025 MUSCULAR FATIGUE Structural and functional responses to prolonged
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025 MUSCULAR FATIGUE Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A67-51251	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET)	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A67-53001	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013 MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253 MICROWAVES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216 Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A67-53001	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216 Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION Structural and functional responses to prolonged
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLAMET) Exobiology revisited p 326 A67-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010 MARS LANDING Exobiology and future Mars missions - The search for	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on
constraints on manual-control parameters  p 319 A87-52828  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY  Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET)  Exobiology revisited p 326 A87-53001  The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARNE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of itie on Mars MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MARS SURFACE	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LAMDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARNE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of itie on Mars MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MARS SURFACE	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100
constraints on manual-control parameters  p 319 A87-52828  Enhancement of human performance in manual target acquisition and tracking  [AD-A183549] p 318 N87-30053  MARINE BIOLOGY  Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET)  Exobiology revisited p 326 A87-53001  The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work
constraints on manual-control parameters  p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLAMET) Exobiology revisited p 326 A67-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024 Radiofrequency radiation safety standards p 312 N87-30030 Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS Possible biological origin of banded irron-formations from	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010 MARS LANDING Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MARS SURFACE Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085	Survival strategies of microorganisms in extreme saline environments p 300 A67-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A67-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A67-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MARS SURFACE The order of Gaust with exposure to continuously increasing accelerations p 321 N87-29085 Mathematical model of pilot head kinematics during	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024 Radiofrequency radiation safety standards p 312 N87-30030 Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY Clay minerals and the origin of life Book	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010 MARS LANDING Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085 Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars iffe on Mars Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085 Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010 MARS LANDING Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011 MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085 Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114 MECHANICAL DRIVES Mobile remote manipulator vehicle system	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 321 N87-29118	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARNE BIOLOGY  Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET)  Exobiology revisited p 326 A87-53001  The Antarctic cold desert and the search for traces of life on Mars  MARS LANDING  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS  Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations  p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations  [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights
constraints on manual-control parameters  p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A67-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm:	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 321 N87-29118	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mar's earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations  p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulator in space p 323 N87-29867	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY  Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET)  Exobiology revisited p 326 A87-53001  The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS  Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAYES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information  MODELS  An electrical circuit model of the interface between an	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A67-53001 The Antarctic cold desert and the search for traces of life on Mars A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentiation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARNE BIOLOGY  Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET)  Exobiology revisited p 326 A87-53001  The Antarctic cold desert and the search for traces of life on Mars  MARS LANDING  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE  Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS  Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations  p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations  [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES  Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NEUROLOGY
constraints on manual-control parameters p 319 A87-52828 Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053 MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251 MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010 MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011 MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085 Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114 MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867 MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112 MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024 Radiofrequency radiation safety standards p 312 N87-30030 Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY Mobile remote manipulator vehicle system (NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023  MOISTURE Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NEUROLOGY  Analyzing the structural and metabolic reactions of the
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112  MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAYES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30030  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023  MOISTURE  Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29100  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A67-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars arilest biosphere p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112  MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH pton of pass and pass a function of pH pton of pAss and pass a function of pH pton of pAss and pass a function of pH pton of pAss a funct	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13993-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023  MOLECULAR BIOLOGY	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NEUROLOGY  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A67-53001 The Antarctic cold desert and the search for traces of life on Mars  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112  MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH p 296 A87-51465	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAYES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024 Radiofrequency radiation safety standards p 312 N87-30030 Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023  MOISTURE Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-3013	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NEUROLOGY  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A67-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars arilest biosphere p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' earliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112  MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH pton of pass and pass a function of pH pton of pAss and pass a function of pH pton of pAss and pass a function of pH pton of pAss a funct	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13993-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023  MOLECULAR BIOLOGY	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NEUROLOGY  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A67-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' aerilest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' aerilest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' aerilest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097 Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112  MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH p 296 A87-51465	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAYES Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024 Radiofrequency radiation safety standards p 312 N87-30030 Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023  MOISTURE Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-30023  MOLECULAR BIOLOGY Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cells p 301 A87-53537	Growth factor involvement in tension-induced skeletal muscle growth [NASA-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29108  N  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29108  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024
Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  MARINE BIOLOGY Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251  MARS (PLANET) Exobiology revisited p 326 A87-53001 The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010  MARS LANDING Exobiology and future Mars missions - The search for Mars' aerliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' aerliest biosphere p 327 A87-53011  MARS SURFACE Exobiology and future Mars missions - The search for Mars' aerliest biosphere p 327 A87-53011  MATHEMATICAL MODELS Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085  Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097  Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114  MECHANICAL DRIVES Mobile remote manipulator vehicle system [NASA-TM-100456] p 311 N87-29118  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867  MEDICAL SERVICES Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112  MEMBRANES Kinetics of the O-photointermediate of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH p 296 A87-51465  MENTAL PERFORMANCE The effect of high temperature on the functional condition and work capacity of an organism	Survival strategies of microorganisms in extreme saline environments p 300 A87-53013  MICROPOROSITY  Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253  MICROWAVES  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects  [AD-A183562] p 305 N87-30024  Radiofrequency radiation safety standards p 312 N87-30030  Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036  MILLIMETER WAVES  Biological effects of millimeter-wave irradiation  [AD-A182890] p 305 N87-30022  MINERAL DEPOSITS  Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828  MINERALOGY  Clay minerals and the origin of life Book p 327 A87-53551  MOBILITY  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 321 N87-29118  MODAL RESPONSE  Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827  MODELS  An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex  [AD-A183204] p 305 N87-30023  MOISTURE  Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103  MOLECULAR BIOLOGY  Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cells p 301 A87-53537	Growth factor involvement in tension-induced skeletal muscle growth [NAS-CR-181349] p 311 N87-30025  MUSCULAR FATIGUE  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR FUNCTION  Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216  MUSCULAR STRENGTH  Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  MUSCULAR TONUS  O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222  MUSCULOSKELETAL SYSTEM  The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29100  NECK (ANATOMY)  Effect of vestibular stimulation on static physical work capacity p 310 N87-29100  NEUROLOGY  Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540  Afferent mechanisms of microwave-induced biological effects [AD-A183562] p 305 N87-30024

PHYSIOLOGICAL TESTS SUBJECT INDEX

NEURONS OPTIMIZATION PH FACTOR The dependence of the vestibular reactions of cat Optimization of peripheral vision the O-photointermediate Kinetics of p 310 N87-29109 bacteriorhodopsin photocycle in native and enzyme treated cortical neurons on the duration and direction of sinusoidal [AD-A182438] purple membrane fragments as a function of pH p 295 A87-51109 ORBITAL MANELIVERING VEHICLES rotation p 296 A87-51465 Reaction of thermoregulatory neurons to different types Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118 PHOSPHORYLATION of sensory stimulation p 295 A87-51110 Energy metabolism of a then archaebacterium, Sulfolobus acidocaldarius ORBITAL SERVICING thermoacidophilic NEUROPHYSIOLOGY Comparative characterization of the sleep-wakefulness Mobile remote manipulator vehicle system p 303 A87-53841 [NASA-CASE-LAR-13393-1] p 321 N87-29118 cycle in hibernating and nonhibernating mammals **PHOTORECEPTORS** p 296 A87-51673 Telerobotic work system: Concept development and p 306 A87-52087 Cone sampling array models **NEUROTRANSMITTERS** p 323 N87-29866 Psychophysical estimate of extrafoveal cone spacing Immunocytochemical localization of glutamic acid **ORBITAL SPACE STATIONS** p 306 A87-52088 decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron Space Station gas-grain simulation facility - Application Cone spacing and the visual resolution limit p 326 A87-53002 to exobiology p 306 A87-52089 p 302 A87-53624 Automated Subsystem Control for Life Support System **PHOTOSYNTHESIS** NUCLEI (CYTOLOGY) Origin and evolution of photosynthetic reaction Investigation of the mechanism of thymocyte death p 321 N87-29117 [NASA-CR-172003] p 303 A87-53843 under ultrahigh gamma-ray doses p 301 A87-53538 **ORGANELLES** PHYSICAL EXERCISE NUCLEIC ACIDS Possible effects of organelle charge and density on cell Work performance evaluation using the exercising rat Studies on the structure of HCN oligomers e to gravitational p 298 A87-52983 metabolism --- chemical response model p 328 A87-53832 stimulus [DE87-0101311 p 303 N87-29078 Nucleic acid-like structures. II - Polynucleotide analogues ORGANIC COMPOUNDS Carotid body contributions to the exercise hypernea in as possible primitive precursors of nucleic acids p 311 N87-29113 Search for organic molecules in the outer solar p 329 A87-53837 p 327 A87-53007 PHYSICAL WORK **NUCLEOTIDES ORTHOSTATIC TOLERANCE** The effect of high temperature on the functional Liposomes with polyribonucleotides as model of Hysteresis in response to descending and ascending condition and work capacity of an organism precellular systems p 328 A87-53835 p 308 A87-52221 p 305 A87-50948 lower-body negative pressure Binding of DNA hairpins to an assembler-strand as part Variant of quantitative evaluation of mechanisms of Carotid body contributions to the exercise hypernea in p 329 A87-53838 of a primordial translation device p 311 N87-29113 central hemodynamic orthostatic reactions PHYSIOCHEMISTRY p 309 N87-29090 Search for catalytic properties of simple polypeptides p 329 A87-53840 Structural and functional responses to prolonged Circulatory changes in carotid artery basin in response p 296 A87-52216 hindlimb suspension in rat muscle A small catalytic oligoribonucleotide to antiorthostasis and antiorthostatic bed rest PHYSIOLOGICAL ACCELERATION p 314 N87-30043 p 303 A87-54091 The dependence of the vestibular reactions of cat NUTRIENTS **OTOLITH ORGANS** cortical neurons on the duration and direction of sinusoidal Porous membrane utilization in plant nutrient delivery Interaction of macula and semicircular canals in angular p 295 A87-51109 p 297 A87-52253 rotation ASAE PAPER 87-0425] p 314 N87-30045 stabilization of man in space PHYSIOLOGICAL EFFECTS NUTRITIONAL REQUIREMENTS OXYGEN CONSUMPTION The effect of high temperature on the functional condition and work capacity of an organism Microbial life at extremely low nutrient levels The effect of elevated oxygen and carbon dioxide p 300 A87-53012 contents in air on the condition of the cardiorespiratory p 305 A87-50948 NYQUIST FREQUENCIES p 306 A87-50950 system The problems of aircraft microclimate (Review of the erature) p 319 A87-50949 Cone spacing and the visual resolution limit OXYGEN REGULATORS p 306 A87-52089 literature) O2 delivery to contracting muscle during hypoxic or CO The effect of elevated oxygen and carbon dioxide A87-52222 contents in air on the condition of the cardiorespiratory system p 306 A87-50950 0 **OXYGEN SUPPLY EQUIPMENT** Incompatibility of the M-1 maneuver with US Navy A possible role for endogenous glucocorticoids in tactical aircraft oxygen systems OCEANS orchiectomy-induced atrophy of the rat levator ani muscle [AD-A183731] p 326 N87-30072 Studies with RU 38486, a potent and selective Bacterial activity in the warmer, sulphate-bearing, p 296 A87-51251 antiglucocorticoid p 296 A87-51151 Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in Symposium on space gastroenterology p 310 N87-29105 the primitive ocean **PHYSIOLOGICAL FACTORS** p 303 A87-53830 OPERATOR PERFORMANCE PALEOBIOLOGY Closing the man-machine loop: On the use of The development of an algorithm for predicting the Exobiology revisited p 326 A87-53001 physiological measures to affect computer-controlled p 322 N87-29507 success of an operator's activity on the basis of a small **PAYLOAD TRANSFER** p 315 A87-50947 learning sample Spatial orientation in flight The design and development of a mobile transporter The human strategies in the formation of subjective [AD-A183431] p 314 N87-30047 system for the Space Station Remote Manipulator **PHYSIOLOGICAL RESPONSES** constraints on manual-control parameters p 323 N87-29865 System p 319 A87-52828 The dependence of the vestibular reactions of cat **PEPTIDÉS** Taking account of rules in the prediction of the possible cortical neurons on the duration and direction of sinusoidal Origin and evolution of photosynthetic reaction strategies of active partners p 319 A87-52829 p 295 centers p 303 A87-53843 Algorithm and program software of an information/measurement system for evaluating the state Reaction of thermoregulatory neurons to different types PERFORMANCE PREDICTION p 295 A87-51110 of sensory stimulation The development of an algorithm for predicting the p 319 A87-52830 of an operator Neuromuscular and mechanical responses to inspiratory success of an operator's activity on the basis of a small The simulation of flexible activity algorithms (For the resistive loading during sleep p 307 A87-52218 p 315 A87-50947 learning sample example of an operator-display system) Algorithm and program software PERIPHERAL VISION p 319 A87-52831 information/measurement system for evaluating the state Some characteristics of peripheral vision The use of individual differences in inferring human of an operator p 319 A87-52830 p 306 A87-51178 p 320 A87-53063 operator intentions Biochemical reception and ionizing irradiation of an Peripheral hyperacuity - Isoeccentric bisection is better Effect of linear, impact and vibration accelerations on organism p 301 A87-53536 p 307 A87-52090 than radial bisection accuracy of operator implementation of strength load Growth hormone secretion during space flight and Cortical magnification and peripheral vision p 316 N87-29086 evaluation of the physiological responses of animals held p 307 A87-52091 Distinctions of psychosomatic correction of performance in the research animal holding facility during continuous long-term work p 316 N87-29093 Contrast discrimination in peripheral vision [NASA-CR-181344] p 303 N87-29077 p 307 A87-52093 Investigation of critical fusion frequency in man during Biological effects of millimeter-wave irradiation p 305 N87-30022 exposure to noise Spatiotemporal properties of grating motion detection [AD-A1828901 Method of enhancing interference resistance of operator Adjustment and validation of the mathematical prediction in the center and the periphery of the visual field erformance p 317 N87-29098 Closing the man-machine loop: On the use of model for sweat rate, heart rate and body temperature performance p 307 A87-52094 under outdoor conditions Accommodation to stimuli in peripheral vision physiological measures to affect computer-controlled p 314 N87-30046 p 307 A87-52095 p 322 N87-29507 PHYSIOLOGICAL TESTS Optimization of peripheral vision In-flight workload assessment using embedded Some characteristics of peripheral vision [AD-A182438] p 310 N87-29109 secondary radio communications tasks p 306 A87-51178 PERSONALITY TESTS p 323 N87-30055 Head-down tilt and restraint on renal function and Evaluation of psychological fitness for flight work Workload methodology N87-30059 p 324 glomerular dynamics in the rat p 296 A87-52215 p 310 N87-29104 OPHTHALMOLOGY Structural and functional responses to prolonged

PERSONNEL

PERSPIRATION

[AD-A183109]

under outdoor conditions

p 311 N87-29112

p 318 N87-30052

Effectiveness of an air cooled vest using selected air

Adjustment and validation of the mathematical prediction

model for sweat rate, heart rate and body temperature

p 326 N87-30071

p 314 N87-30046

temperature, humidity and air flow rate, combinations

Activities report in aerospace medicine

Formation of spatial position image with onset of illusions of vestibular origin p 309 N87-29082

Visual input requirements relating to pursuit tracking

[ETN-87-90153]

OPTICAL ILLUSIÓN

OPTICAL TRACKING

accuracy [AD-A183445] p 296 A87-52216

p 307 A87-52219

p 308 A87-52221

p 300 A87-53533

hindlimb suspension in rat muscle

lower-body negative pressure

acute exposure to heat

Hypoxia and monosynaptic reflexes in humans

Hysteresis in response to descending and ascending

O2 delivery to contracting muscle during hypoxic or CO ypoxia p 297 A87-52222
Changes in the cardiac rhythm and its regulation during

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to cooling or p 301 A87-53534 overheating Peroxidation of lipids and the concentration of alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression p 301 A87-53535 PHYSIOLOGY USSR Report: Life Sciences. Biomedical and behavioral eciences [JPRS-UBB-87-009] n 314 N87-30042 PILOT ERROR The task taxonomy method: A basis for an expert system p 318 N87-29506 on human reliability PILOT PERFORMANCE The problems of aircraft microclimate (Review of the p 319 A87-50949 literature) Improving visual performance through volitional focus p 306 A87-51163 Hesitations in continuous tracking induced by concurrent discrete task p 315 A87-51164 Formation of spatial position image with onset of illusions of vestibular origin p 309 N87-29082 Alcohol, emotions, stress and performance p.316 N87-29083 Psychological control of health status during long-term exposure to longitudinal accelerations p 317 N87-29107 Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment p 317 N87-29115 [DFVLR-FB-86-61] Flight simulation motion-base drive algorithms. Part 3: Pilot evaluations p 317 N87-29116 [UTIAS-319] Automation at the man-machine interface p 322 N87-29504 Study of anticipation mechanisms in the aeronautical p 317 N87-29505 environment A study of pilot flight information crossmonitoring promance p 322 N87-29509 performance Spatial orientation in flight p 314 N87-30047 [AD-A183431] Spatial ability as a predictor of flight training p 318 N87-30050 [AD-A183141] The practical assessment of pilot workload p 323 N87-30054 [AGARD-AG-282] Pilot subjective evaluation of workload during a flight p 324 N87-30057 test certification programme Mental workload measurement in operational aircraft systems: Two promising approaches p 318 N87-30060 In-flight assessment of workload using instrument p 324 N87-30062 Flight test evaluation of crew workload. Part 1: Aircraft certification for a minimum crew of two pilots p 324 N87-30063 In-flight assessment of workload using pilot ratings and heart rate p 315 N87-30065 The assessment of workload in helicopters p 325 N87-30066 Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067 p 325 N87-30068 Measurement of pilot workload Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069 Incompatibility of the M-1 maneuver with US Navy tactical aircraft oxygen systems p 326 N87-30072 [AD-A183731] PILOT SELECTION Scientific theoretical problems of validating the system for sociopsychological screening of flight personne

p 316 N87-29081 PILOT TRAINING Improving visual performance through volitional focus p 306 A87-51163 control Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel p 316 N87-29081

Evaluation of psychological fitness for flight work p 310 N87-29104 Spatial ability as a predictor of flight training p 318 N87-30050 (AD-A183141) PITUITARY GLAND Flow cytometric immunofluorescence of rat anterior p 302 A87-53619 Effect of pituitary hollow fiber units and thyroid

supplementation on growth in the little mouse (41949) p 302 A87-53629 Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and p 302 A87-53649 perpendicular light scatter

Flow cytometric analysis and sorting of live female rat anterior pituitary cell types by forward angle and perpendicular light scatter - Effect of 17 beta-estradiol p 302 A87-53650

PLANETARY ATMOSPHERES

Search for organic molecules in the outer solar p 327 A87-53007 system

PLANETARY EVOLUTION

Exobiology and future Mars missions - The search for p 327 A87-53011 Mars' earliest biosphere

PLANT ROOTS

of root statocytes Relevance n 298 A87-52984 graviperception Role of calcium in gravity perception of plant roots p 298 A87-52985

Distribution of calmodulin in corn seedlings Immunocytochemical localization in coleoptiles and root p 299 A87-52986 apices

PLANT STRESS

Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985) p 300 A87-52997

DOL ARITY

of root statocytes Relevance Polarity p 298 A87-52984 graviperception

POLYMERIZATION

Search for catalytic properties of simple polypeptides p 329 A87-53840

**POLYNUCLEOTIDES** 

Kinetic analysis template p 329 A87-53836 ribooligoguanylate elongation Nucleic acid-like structures, II - Polynucleotide analogues as possible primitive precursors of nucleic acids p 329 A87-53837

Binding of DNA hairpins to an assembler-strand as part p 329 A87-53838 of a primordial translation device

**POLYPEPTIDES** 

Selective emergence and survival of early polypeptides p 329 A87-53839 Search for catalytic properties of simple polypeptides p 329 A87-53840

PORPHYRINS

Origin and evolution of photosynthetic reaction p 303 A87-53843

POSITION (LOCATION)

Formation of spatial position image with onset of illusions p 309 N87-29082 of vestibular origin

POSITIONING

Tracking a laser-projected horizon indicator p 318 N87-30051 [AD-A183384]

POSTFLIGHT ANALYSIS

Measurement of aircrew workload during low-level flight Part 1: A comparison between in-flight and post flight p 325 N87-30064 assessment methods

POSTURE

Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions p 309 N87-29090

Role of orientation reference selection in motion sickness, supplement 2S

[NASA-CR-181393] p 315 N87-30049

POTABLE WATER

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305

PREDICTION ANALYSIS TECHNIQUES

Adjustment and validation of the mathematical prediction model for sweat rate, heart rate and body temperature under outdoor conditions

[AD-A183109]

p 314 N87-30046 **PREDICTIONS** Empirical models for use in designing decompression procedures for space operations

NASA-TM-1004561 PRESSURE RREATHING

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 311 N87-29114

p 321 N87-29085

PRESSURE REDUCTION

Peroxidation of lipids and the concentration of alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression p 301 A87-53535

PRESSURE SUITS

Incompatibility of the M-1 maneuver with US Navy tactical aircraft oxygen systems [AD-A1837311 p 326 N87-30072

PRIMITIVE EARTH ATMOSPHERE

Hypotheses on the appearance of life on earth p 326 A87-53000 (Review)

PROBABILITY THEORY

The task taxonomy method: A basis for an expert system p 318 N87-29506 on human reliability

PROPRIOCEPTION

Role of orientation reference selection in motion sickness, supplement 2S

[NASA-CR-181393] p 315 N87-30049 PROTECTIVE CLOTHING

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations p 326

PROTEIN METAROLISM

Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for p 304 N87-29095

PROTEIN SYNTHESIS

Prebiotic synthesis of imidazole-4-acetaldehyde and p 328 A87-53833 histidina Structural elements and organization of the ancestral translational machinery p 330 A87-53844 Information theory and the genetic code

p 320 A87-53845

**PROTEINS** 

of the O-photointermediate Kinetics bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH p 296 A87-51465

Distribution of calmodulin in corn seedlings -Immunocytochemical localization in coleoptiles and root p 299 A87-52986 apices

The effect of microgravity on plasma-osteocalcin p 308 A87-52994

Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for 6 p 304 N87-29095

PROTON ENERGY

Biological effectiveness of helium ions and protons of p 301 A87-53539

PSYCHOLOGICAL FACTORS

Improving visual performance through volitional focus p 306 A87-51163 control Scientific theoretical problems of validating the system for sociopsychological screening of flight personne p 316 N87-29081

Review of Potegal book on spatial abilities of man p 317 N87-29106

Spatial ability as a predictor of flight training IAD-A1831411 n 318 N87-30050

PSYCHOLOGICAL TESTS

Evaluation of psychological fitness for flight work p 310 N87-29104

**PSYCHOLOGY** 

USSR Space Life Sciences Digest, issue 13 [NASA-CR-3922(15)] p 304 N87-29079

**PSYCHOPHYSIOLOGY** 

Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088 Estimation of local spatial scale p 316 A87-52092

Contrast discrimination in peripheral vision p 307 A87-52093

Scientific theoretical problems of validating the system

for sociopsychological screening of flight personnel p 316 N87-29081

**PSYCHOSOMATICS** 

Distinctions of psychosomatic correction of performance during continuous long-term work p 316 N87-29093

**PULMONARY FUNCTIONS** Incompatibility of the M-1 maneuver with US Navy

tactical aircraft oxygen systems [AD-A1837311 p 326 N87-30072

PURSUIT TRACKING

Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p.318 N87-30052

Q

Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of p 319 A87-52827

RADAR TRACKING

Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of p 319 A87-52827 information

RADIATION ABSORPTION

Dielectric behaviour of water in biological material with p 313 N87-30036 particular reference to brain tissue RADIATION DAMAGE

Formation of single-strand breaks in DNA under the effect of high-intensity UV radiation p 295 A87-51125 SUBJECT INDEX SALINITY

Genetic and physiological damage induced by cosmic **RADIATION SICKNESS** REFLEXES radiation on dry plant seeds during space flight Biochemical reception and ionizing irradiation of an Hypoxia and monosynaptic reflexes in humans p 299 A87-52993 organism p 301 A87-53536 p 307 A87-52219 RADIATION TOLERANCE JPRS Report: Science and technology. USSR: Space REGULATORY MECHANISMS (BIOLOGY) Biology and Aerospace Medicine, Volume 21, No. 2, March Radiation stability of organic matter in liquid and frozen Changes in the cardiac rhythm and its regulation during H2O, NH3 and water-ammonia mixtures p 300 A87-53533 - April 1987 acute exposure to heat p 309 N87-29080 p 326 A87-53003 [JPRS-USB-87-004] REMOTE CONTROL **RADIO FREQUENCIES** Proceedings of a Workshop on Radiofrequency Telerobotic work system: Concept development and Proceedings of a Workshop on Radiofrequency Radiation Bioeffects p 323 N87-29866 Radiation Bioeffects [AD-A157090] p 312 N87-30026 REMOTE MANIPULATOR SYSTEM [AD-A157090] p 312 N87-30026 Critical review of selected topics on biological effects Development of a small-sized space manipulator Radiofrequency radiation safety of two manpack of radiofrequency radiation p 312 N87-30029 p 319 A87-51979 transceivers (AN/PRC-515 and AN/PRC-77) Human exposures to radiofrequency radiation (RFR). A Mobile remote manipulator vehicle system p 313 N87-30039 [NASA-CASE-LAR-13393-1] p 321 N87-29118 review of RFR accidents p 312 N87-30033 Specific absorption rate distributions in a heterogeneous Application of human whole-body RF absorption The design and development of a mobile transporter model of the human body at radiofrequencies measurements to RFR safety standards system for the Space Station Remote Manipulator p 313 N87-30040 PB87-2013561 p 313 N87-30034 RADIO TRANSMITTERS System p 323 N87-29865 RADIATION DISTRIBUTION RENAL FUNCTION Exposure to radiofrequency fields in the Netherlands: Physical interactions of radiofrequency radiation fields Head-down tilt and restraint on renal function and p 313 N87-30035 Measurements and evaluation p 312 N87-30027 and biological systems glomerular dynamics in the rat p 296 A87-52215 RADIATION DOSAGE Proceedings of a Workshop Radiation Bioeffects REQUIREMENTS on Radiofrequency Cellular molecular mechanisms of the biological effect Concept of functional strength in the problem of of low X-ray doses on isolated mammalian cells p 312 N87-30026 objectivization of biomechanical specifications for p 301 A87-53537 protective and rescue gear for aircraft crews Physical interactions of radiofrequency radiation fields p 321 N87-29084 Investigation of the mechanism of thymocyte death and biological systems p 312 N87-30027 Thermal physiology of RFR interactions in animals and p 301 A87-53538 RESEARCH AND DEVELOPMENT under ultrahigh gamma-ray doses p 312 N87-30028 Proceedings of a Workshop on Radiofrequency Development of a small-sized space manipulator Critical review of selected topics on biological effects Radiation Bioeffects p 319 A87-51979 p 312 N87-30029 p 312 N87-30026 of radiofrequency radiation [AD-A157090] RESPIRATION RFR research projections for the future Thermal physiology of RFR interactions in animals and Work performance evaluation using the exercising rat p 312 N87-30028 p 312 N87-30031 humans model Critical review of selected topics on biological effects fradiofrequency radiation p 312 N87-30029 The cumulative effects of long-term exposure to low [DE87-010131] p 303 N87-29078 levels of radiofrequency radiation (RFR) of radiofrequency radiation Incompatibility of the M-1 maneuver with US Navy p 312 N87-30032 Radiofrequency radiation safety standards tactical aircraft oxygen systems Human exposures to radiofrequency radiation (RFR). A p 312 N87-30030 [AD-A1837311 p 312 N87-30033 p 326 N87-30072 review of RFR accidents p 312 N87-30033
Application of human whole-body RF absorption RFR research projections for the future RESPIRATORY PHYSIOLOGY p 312 N87-30031 The effect of elevated oxygen and carbon dioxide measurements to RFR safety standards The cumulative effects of long-term exposure to low contents in air on the condition of the cardiorespiratory p 313 N87-30034 levels of radiofrequency radiation (RFR) p 312 N87-30032 Exposure to radiofrequency fields in the Netherlands: RESPIRATORY REFLEXES Measurements and evaluation Human exposures to radiofrequency radiation (RFR). A p 313 N87-30035 Neuromuscular and mechanical responses to inspiratory Application of human whole-body RF absorption review of RFR accidents Radiofrequency radiation safety guidelines in the Federal resistive loading during sleep p 307 A87-52218 Republic of Germany p 313 N87-30038 RESPIRATORY SYSTEM Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77) measurements to RFR safety standards Functional state of the human cardiorespiratory system p 313 N87-30034 following 30-day antiorthostatic hypokinesia p 313 N87-30039 Exposure to radiofrequency fields in the Netherlands: p 309 N87-29089 RADIOBIOLOGY p 313 N87-30035 Measurements and evaluation **RADIATION EFFECTS** Cellular molecular mechanisms of the biological effect Psychophysical estimate of extrafoveal cone spacing Embryogenesis and organogenesis of Carausius of low X-ray doses on isolated mammalian cells p 306 A87-52088 morosus under spaceflight conditions p 301 A87-53537 Cone spacing and the visual resolution limit p 299 A87-52991 Investigation of the mechanism of thymocyte death p 306 A87-52089 Biological effectiveness of belium ions and protons of under ultrahigh gamma-ray doses p 301 A87-53538 RIBONUCLEIC ACIDS Biological effectiveness of helium ions and protons of relativistic energies p 301 A87-53539 A small catalytic oligoribonucleotide p 301 A87-53539 Analyzing the structural and metabolic reactions of the relativistic energies p 303 A87-54091 Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of ROBOTICS microwave and ionizing radiation central nervous system to the combined effects of p 301 A87-53540 Telerobotic work system: Concept development and p 301 A87-53540 Biological effects of millimeter-wave irradiation microwave and ionizing radiation p 323 N87-29866 [AD-A182890] p 305 N87-30022 Changes in rat hemopolesis as a result of the combined Traction-drive, seven-degree-of-freedom telerobot arm: effect of accelerations, radiation and radiation-modifying Afferent mechanisms of microwave-induced biological A concept for manipulaton in space p 323 N87-29867 effects agents p 304 N87-29101 ROBOTS RATS [AD-A183562] n 305 N87-30024 Robot manipulators for sample handling in space p 320 A87-53921 Work performance evaluation using the exercising rat Physical interactions of radiofrequency radiation fields and biological systems p 312 N87-30027 model RODENTS [DE87-010131] **RADIATION HAZARDS** p 303 N87-29078 Growth hormone secretion during space flight and Critical review of selected topics on biological effects Changes in rat hemopoiesis as a result of the combined evaluation of the physiological responses of animals held p 312 N87-30029 effect of accelerations, radiation and radiation-modifying of radiofrequency radiation in the research animal holding facility The cumulative effects of long-term exposure to low p 304 N87-29101 [NASA-CR-181344] p 303 N87-29077 Afferent mechanisms of microwave-induced biological levels of radiofrequency radiation (RFR) ROTATION p 312 N87-30032 effects Role of orientation reference selection in motion Human exposures to radiofrequency radiation (RFR). A [AD-A183562] p 305 N87-30024 sickness, supplement 2S review of RFR accidents p 312 N87-30033 REACTION KINETICS [NASA-CR-181393] p 315 N87-30049 Kinetic analysis of the template Evaluation of human exposure to low frequency fields effect p 313 N87-30037 ribooligoguanylate elongation p 329 A87-53836 REAL TIME OPERATION RADIATION INJURIES Flight simulation motion-base drive algorithms. Part 3: Dynamics of noncollagen protein metabolism in dogs Pilot evaluations exposed to low doses of chronic gamma radiation for 6 SAFETY p 304 N87-29095 [UTIAS-319] p 317 N87-29116 years Radiofrequency radiation safety standards RECEPTORS (PHYSIOLOGY) Changes in rat hemopoiesis as a result of the combined p 312 N87-30030 effect of accelerations, radiation and radiation-modifying Status of Alpha 1-adrenergic regulation of stroke volume Radiofrequency radiation safety guidelines in the Federal p 304 N87-29101 in hypokinetic rats p 304 N87-29091 agents Republic of Germany p 313 N87-30038 RADIATION MEASUREMENT RECORDING INSTRUMENTS Radiofrequency radiation safety of tw transceivers (AN/PRC-515 and AN/PRC-77) of two manpack Dosimetric mapping inside Biorack Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment p 320 A87-52990 p 317 N87-29115 The measured radiation environment within Spacelabs [DFVLR-FB-86-61] SAFETY DEVICES 1 and 2 and comparison with predictions REDOX CELLS Concept of functional strength in the problem of Radiation stability of organic matter in liquid and frozen p 320 A87-52992 objectivization of biomechanical specifications for H2O, NH3 and water-ammonia mixtures Exposure to radiofrequency fields in the Netherlands: protective and rescue gear for aircraft crews p 326 A87-53003 Measurements and evaluation p 313 N87-30035 p 321 N87-29084

REDUCED GRAVITY

and gravity orientation

Amphibian egg cytoplasm response to altered g-forces

The musculo-skeletal system in man - Development

structure and function in dependence on gravity, and

potential limitations for long term space flights

p 297 A87-52979

p 308 A87-53016

RADIATION PROTECTION

measurements to RFR safety standards

agents

Changes in rat hemopolesis as a result of the combined

Application of human whole-body RF absorption

p 304 N87-29101

p 313 N87-30034

effect of accelerations, radiation and radiation-modifying

p 321 N87-29117

p 300 A87-53013

SAFETY FACTORS

[NASA-CR-172003]

(ASCLSS)

environments

SALINITY

Automated Subsystem Control for Life Support System

Survival strategies of microorganisms in extreme saline

SCALE EFFECT	SPACE SUITS	STRESS (PHYSIOLOGY)
Cortical magnification and peripheral vision	Theoretical analysis of efficacy of G suits with exposure	The effect of adaptation to cold and of short-term
p 307 A87-52091	to continuously increasing accelerations	exposure to cold on the resistance of animals to hypoxic
Estimation of local spatial scale p 316 A87-52092	p 321 N87-29085	hypoxia p 295 A87-51108
SCANNING	SPACEBORNE EXPERIMENTS	Adaptability of the rat hypokinetic heart to afterload, and
In-flight assessment of workload using instrument	Life sciences and space research XXII(2); Proceedings	the role of nervous regulation p 304 N87-29092
scan p 324 N87-30062	of the Topical Meeting and Workshop 4 of the 26th	Adjustment and validation of the mathematical prediction
SEEDS	COSPAR Plenary Meeting, Toulouse, France, June 30-July	model for sweat rate, heart rate and body temperature
Genetic and physiological damage induced by cosmic	11, 1986 p 297 A87-52976	under outdoor conditions
radiation on dry plant seeds during space flight	Effects of gravity perturbation on developing animal	[AD-A183109] p 314 N87-30046
p 299 A87-52993	systems p 298 A87-52980	Effectiveness of an air cooled vest using selected air
SEMICIRCULAR CANALS	Interaction of growth-determining systems with gravity	temperature, humidity and air flow rate, combinations
Interaction of macula and semicircular canals in angular	p 299 A87-52987	[AD-A183298] p 326 N87-30071
stabilization of man in space p 314 N87-30045	Bioscience experiments in the German Spacelab	STRESS (PSYCHOLOGY)
SENSE ORGANS	mission D-1 - Introduction and summary	Changes in binding by the corticosterone receptors in
The origin and evolution and comparative physiology	p 299 A87-52988	different brain structures of rats under immobilization
of gravity sensing organs p 298 A87-52982	Investigations onboard the biosatellite Cosmos-1667	stress p 295 A87-51106
SENSORIMOTOR PERFORMANCE	p 299 A87-52989	Alcohol, emotions, stress and performance
The development of an algorithm for predicting the	Dosimetric mapping inside Biorack	p 316 N87-29083
success of an operator's activity on the basis of a small	p 320 A87-52990	SULFATES
learning sample p 315 A87-50947	Embryogenesis and organogenesis of Carausius	Bacterial activity in the warmer, sulphate-bearing,
Part-task training strategies in simulated carrier landing	morosus under spaceflight conditions	Archaean oceans p 296 A87-51251
final-approach training p 315 A87-51162	p 299 A87-52991	SURVIVAL
SENSORY PERCEPTION	Genetic and physiological damage induced by cosmic	Survival under space vacuum - Biochemical aspects
Spatial orientation in flight	radiation on dry plant seeds during space flight	p 327 A87-53014
[AD-A183431] p 314 N87-30047	p 299 A87-52993	SWEAT
SENSORY STIMULATION	Confirmation of gravisensitivity in the slime mold	Adjustment and validation of the mathematical prediction
Reaction of thermoregulatory neurons to different types	Physarum polycephalum under near weightlessness	model for sweat rate, heart rate and body temperature under outdoor conditions
of sensory stimulation p 295 A87-51110	p 300 A87-52995	
SEQUENTIAL CONTROL	Survey of the vestibulum, and behavior of Xenopus laevis	[AD-A183109] p 314 N87-30046
Dynamic task allocation for a man-machine symbiotic	larvae developed during a 7-days space flight	SYMPATHETIC NERVOUS SYSTEM  Changes in the carding rhythm and its regulation during
system	p 300 A87-52996	Changes in the cardiac rhythm and its regulation during
[DE87-011950] p 325 N87-30070	Space Station gas-grain simulation facility - Application	acute exposure to heat p 300 A87-53533
SIMULATION	to exobiology p 326 A87-53002	Adaptability of the rat hypokinetic heart to afterload, and
An electrical circuit model of the interface between an	Survey of earth orbital telescopes and their potential	the role of nervous regulation p 304 N87-29092
electrode and the electrolytic medium of the cortex	for exobiology p 327 A87-53005	SYSTEMS ANALYSIS
[AD-A183204] p 305 N87-30023	Systems interrelations of gravity responses in the human	Estimating the operational quality of man-machine
SLEEP	organism, and the use of modelling p 308 A87-53015	systems with bimodal and monomodal presentation of
Comparative characterization of the sleep-wakefulness	Human capabilities in space	information p 319 A87-52827 SYSTEMS ENGINEERING
cycle in hibernating and nonhibernating mammals	[AAS PAPER 86-114] p 320 A87-53089	Development of a small-sized space manipulator
p 296 A87-51673	Execution of 'ARC' experiment on Space Shuttle	p 319 A87-51979
Neuromuscular and mechanical responses to inspiratory	'Discovery' STS 51-C - Some results on aggregation of	p 518 - A01-51818
resistive loading during sleep p 307 A87-52218	red blood cells under zero gravity Aggregation of Red	-
SOFTWARE TOOLS  Algorithm and program software of an	blood Cells p 309 A87-53620	
	SPACEBORNE TELESCOPES	
information/measurement system for evaluating the state of an operator p 319 A87-52830	Survey of earth orbital telescopes and their potential	TARGET ACQUISITION
	for exobiology p 327 A87-53005	Enhancement of human performance in manual target
SOLAR SYSTEM	SPACECRAFT CABIN SIMULATORS	Enhancement of human performance in manual target acquisition and tracking
SOLAR SYSTEM Search for organic molecules in the outer solar	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station	
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979	acquisition and tracking
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007 SPACE ADAPTATION SYNDROME	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979 SPACECRAFT CONTAMINATION	acquisition and tracking [AD-A183549] p 318 N87-30053
SOLAR SYSTEM Search for organic molecules in the outer solar system  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station	acquisition and tracking [AD-A183549] p 318 N87-30053 TARGET RECOGNITION
SOLAR SYSTEM Search for organic molecules in the outer solar system SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants  p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants  p 321 A87-53979	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052
SOLAR SYSTEM Search for organic molecules in the outer solar system SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants  p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants  p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy
SOLAR SYSTEM Search for organic molecules in the outer solar system  SPACE ADAPTATION SYNDROME  Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY
SOLAR SYSTEM Search for organic molecules in the outer solar system  SPACE ADAPTATION SYNDROME  Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT  Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS  The effect of microgravity on plasma-osteocalcin p 308 A87-52994  Symposium on space gastroenterology p 310 N87-29105	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A67-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994  Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52982  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  A study of pilot flight information crossmonitoring
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A67-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AS PAPER 86-119] p 320 A87-53092	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994  Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52982  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPEECH RECOGNITION	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man	A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary  p 299 A87-52988 The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52982  SPATIAL DISTRIBUTION Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION Levels of analysis of complex auditory stimuli	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 In-flight workload assessment using embedded secondary radio communications tasks
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPEECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] The effects of display-control I/O, compatibility, and	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 embedded secondary radio communications tasks
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPEECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 In-flight workload assessment using embedded secondary radio communications tasks  p 323 N87-30055  Use of task timeline analysis to assess crew workload
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 29 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52982  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 embedded secondary radio communications tasks
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology Symposium on space gastroenterology Back Paler 8-119 p 320 A87-53092  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary  p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions  p 320 A87-52988  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECEC HECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  SPINE  Treatment of degenerative diseases of the spine by	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055  Use of task timeline analysis to assess crew workload p 329 N87-30056  Pilot subjective evaluation of workload during a flight
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52988  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  A study of pilot flight information cross-monitoring performance p 322 N87-29508  The practical assessment of pilot workload  [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks  p 323 N87-30055  Use of task timeline analysis to assess crew workload  p 323 N87-30056
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PRECEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13399-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight  [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli  [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055  Use of task timeline analysis to assess crew workload p 329 N87-30056  Pilot subjective evaluation of workload during a flight
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary  p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions  p 320 A87-52988  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight  [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECCH RECOGNITION  Levels of analysis of complex auditory stimuli  [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  SPINE  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  SPLEEN	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994  Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space	A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988 The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52988  SPATIAL DISTRIBUTION Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088 Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN Changes in rat hemopoiesis as a result of the combined	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055  Use of task timeline analysis to assess crew workload p 323 N87-30055  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30057  The use of subjective workload assessment technique in a complex flight task p 324 N87-30058
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PRECEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53921	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN  Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055  Use of task timeline analysis to assess crew workload p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  The use of subjective workload assessment technique in a complex flight task p 324 N87-30058  Workload methodology p 324 N87-30059
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-5295 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary  p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions  p 320 A87-52988  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight  [AD-A183431]  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli  [AD-A182699]  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  P 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613]  P 310 N87-29108  SPLEEN  Changes in rat hemopolesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents  P 304 N87-29101	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks  p 323 N87-30055  Vise of task timeline analysis to assess crew workload p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30057  The use of subjective workload assessment technique in a complex flight task p 324 N87-30059  The assessment of workload in helicopters
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994  Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-52095 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53921  SPACE PROGRAMS Human capabilities in space	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN  Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 314 N87-29101	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51165  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29509  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using secondary radio communications tasks p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30057  The use of subjective workload assessment technique in a complex flight task p 324 N87-30058  Workload methodology p 324 N87-30059  The assessment of workload in helicopters p 325 N87-30056
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PROCEDION Accommodation to stimuli in peripheral vision p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-5297  Robot manipulators for sample handling in space p 290 A87-53921  SPACE PROGRAMS Human capabilities in space [AAS PAPER 86-114] p 320 A87-53089	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight  [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli  [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy  [DRIC-T-7613] p 310 N87-29108  SPLEEN  Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents  STANDARDS  Radiofrequency radiation safety standards	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055  Use of task timeline analysis to assess crew workload p 323 N87-30055  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  The assessment of workload in helicopters p 325 N87-30056  Investigation of workload in helicopters p 325 N87-30066
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE MANUFACTURING Development of a small-sized space manipulator p 307 A87-5295 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53921  SPACE PROGRAMS Human capabilities in space [AAS PAPER 86-114] p 320 A87-53089  SPACE SHUTTLE ORBITERS	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPEECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN  Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101  STANDARDS  Radiofrequency radiation safety standards	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 embedded secondary radio communications tasks p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  The use of subjective workload assessment technique in a complex flight task p 324 N87-30056  Workload methodology p 324 N87-30056  Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30066
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-5295 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53921  SPACE PROGRAMS Human capabilities in space [AAS PAPER 86-114] p 320 A87-53089  SPACE SHUTTLE ORBITERS The design and development of a mobile transporter	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988 The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52988  SPATIAL DISTRIBUTION Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload  SPINE Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents P 312 N87-30030 Application of human whole-body RF absorption	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29509  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PRECEPTION Accommodation to stimuli in peripheral vision p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-5297  Robot manipulators for sample handling in space p 297 A87-5297  Robot manipulators for sample handling in space [AAS PAPER 86-114] p 320 A87-53089  SPACE SHUTTLE ORBITERS The design and development of a mobile transporter system for the Space Station Remote Manipulator	SPACECRAFT CABIN SIMULATORS  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION  A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS  Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988  The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52982  SPATIAL DISTRIBUTION  Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION  Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION  Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN  Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents  P 304 N87-29101  STANDARDS  Radiofrequency radiation safety standards p 312 N87-30030  Application of human whole-body RF absorption measurements to RFR safety standards	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks p 323 N87-30055  Use of task timeline analysis to assess crew workload p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30055  The use of subjective workload assessment technique in a complex flight task p 324 N87-30055  The assessment of workload measuring techniques: A theoretical and practical framework p 325 N87-30066  TASKS  Role of orientation reference selection in motion
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-5295 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53092  SPACE PROGRAMS Human capabilities in space (AAS PAPER 86-114] p 320 A87-53089  SPACE SHUTTLE ORBITERS The design and development of a mobile transporter system for the Space Station Remote Manipulator System p 323 N87-29865	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988 The measured radiation environment within Spacelab and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION Estimation of local spatial scale p 316 A87-52092  SPEECH RECOGNITION Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101  STANDARDS Radiofrequency radiation safety standards p 312 N87-30030 Application of human whole-body RF absorption measurements to RFR safety standards p 313 N87-30034	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 embedded secondary radio communications tasks  Use of task timeline analysis to assess crew workload p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  The use of subjective workload assessment technique in a complex flight task p 324 N87-30056  Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30066  TASKS  Role of orientation reference selection in motion sickness, supplement 25
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-5295 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53921  SPACE PROGRAMS Human capabilities in space [AAS PAPER 86-114] p 320 A87-53089  SPACE SHUTTLE ORBITERS The design and development of a mobile transporter system for the Space Station Remote Manipulator System p 320 N87-29865	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 29 A87-52988 The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52982  SPATIAL DISTRIBUTION Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION Estimation of local spatial scale p 316 A87-52092  SPECH RECOGNITION Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101  STANDARDS Radiofrequency radiation safety standards p 312 N87-30030 Application of human whole-body RF absorption measurements to RFR safety standards p 311 N87-30034 Radiofrequency radiation safety guidelines in the Federal	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information cross-monitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054  In-flight workload assessment using embedded secondary radio communications tasks
SOLAR SYSTEM Search for organic molecules in the outer solar system p 327 A87-53007  SPACE ADAPTATION SYNDROME Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077  SPACE FLIGHT STRESS The effect of microgravity on plasma-osteocalcin p 308 A87-52994 Symposium on space gastroenterology p 310 N87-29105  SPACE HABITATS Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092  SPACE MANUFACTURING Development of a small-sized space manipulator p 319 A87-51979  SPACE PERCEPTION Accommodation to stimuli in peripheral vision p 307 A87-5295 Review of Potegal book on spatial abilities of man p 317 N87-29106  SPACE PLATFORMS Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118  SPACE PROCESSING Physical parameters affecting living cells in space p 297 A87-52977 Robot manipulators for sample handling in space p 320 A87-53092  SPACE PROGRAMS Human capabilities in space (AAS PAPER 86-114] p 320 A87-53089  SPACE SHUTTLE ORBITERS The design and development of a mobile transporter system for the Space Station Remote Manipulator System p 323 N87-29865	SPACECRAFT CABIN SIMULATORS A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT CONTAMINATION A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979  SPACECRAFT ENVIRONMENTS The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992  SPACELAB PAYLOADS Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary p 299 A87-52988 The measured radiation environment within Spacelab and 2 and comparison with predictions p 320 A87-52992  SPATIAL DISTRIBUTION Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088  Spatial orientation in flight [AD-A183431] p 314 N87-30047  SPATIAL RESOLUTION Estimation of local spatial scale p 316 A87-52092  SPEECH RECOGNITION Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110 The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  SPINE  Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108  SPLEEN Changes in rat hemopoiesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101  STANDARDS Radiofrequency radiation safety standards p 312 N87-30030 Application of human whole-body RF absorption measurements to RFR safety standards p 313 N87-30034	acquisition and tracking [AD-A183549] p 318 N87-30053  TARGET RECOGNITION  Visual input requirements relating to pursuit tracking accuracy [AD-A183445] p 318 N87-30052  Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053  TASK COMPLEXITY  Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162  A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165  The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506  The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508  A study of pilot flight information crossmonitoring performance p 322 N87-29509  The practical assessment of pilot workload [AGARD-AG-282] p 323 N87-30054 embedded secondary radio communications tasks  Use of task timeline analysis to assess crew workload p 323 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30056  The use of subjective workload assessment technique in a complex flight task p 324 N87-30056  Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30066  TASKS  Role of orientation reference selection in motion sickness, supplement 25

Taking account of rules in the prediction of the possible trategies of active partners p 319 A87-52829

strategies of active partners

[AD-A183141]

Measurement of pilot workload

p 318 N87-30050

p 325 N87-30068

A simulation model for the analysis of Space Station as-phase trace contaminants p 321 A87-53979

gas-phase trace contaminants

SUBJECT INDEX WHITE NOISE

Dynamic task allocation for a man-machine symbiotic TRAINING ANALYSIS Cortical magnification and peripheral vision p 307 A87-52091 system Method of enhancing interference resistance of operator [DE87-011950] performance p 317 N87-29098 p 325 N87-30070 VISUAL DISCRIMINATION TRANSMITTER RECEIVERS TELEOPERATORS Contrast discrimination in peripheral vision Robot manipulators for sample handling in space Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77) p 307 A87-52093 p 320 A87-53921 VISUAL PERCEPTION p 313 N87-30039 Telerobotic work system: Concept development and Some characteristics of peripheral vision p 323 N87-29866 TRANSPORTER evolution p 306 A87-51178 Traction-drive, seven-degree-of-freedom telerobot arm: The design and development of a mobile transporter Interaction between colour and motion in human system for the Space Station Remote Manipulator A concept for manipulaton in space p 323 N87-29867 p 316 A87-54098 p 323 N87-29865 **TEMPERATURE EFFECTS** System Formation of spatial position image with onset of illusions Changes in the cardiac rhythm and its regulation during of vestibular origin p 309 N87-29082 p 300 A87-53533 The design and development of a mobile transporter acute exposure to heat Investigation of critical fusion frequency in man during The activities of acid and the alkaline phosphatases in system for the Space Station Remote Manipulator p 323 N87-29865 exposure to noise p 317 N87-29094 tissues of an organism subjected to cooling or Organization of displays in the visual space of the combat p 301 A87-53534 p 322 N87-29516 TEMPI ATES Role of orientation reference selection in motion Kinetic analysis of the template effect ribooligoguanylate elongation p 329 A87-53836 sickness, supplement 2S U.S.S.R. SPACE PROGRAM INASA-CR-1813931 TEMPORAL RESOLUTION n 315 N87-30049 USSR Space Life Sciences Digest, issue 13 Visual input requirements relating to pursuit tracking Spatiotemporal properties of grating motion detection NASA-CR-3922(15)] p 304 N87-29079 in the center and the periphery of the visual field accuracy p 307 A87-52094 **ULTRAHIGH VACUUM** [AD-A183445] p 318 N87-30052 Survival under space vacuum - Biochemical aspects TENSION Enhancement of human performance in manual target p 327 A87-53014 Growth factor involvement in tension-induced skeletal acquisition and tracking **ULTRAVIOLET LASERS** muscle growth [NASA-CR-181349] [AD-A183549] p 318 N87-30053 Formation of single-strand breaks in DNA under the p 311 N87-30025 VISUAL STIMULI effect of high-intensity UV radiation p 295 A87-51125 THERAPY Cortical magnification and peripheral vision Treatment of degenerative diseases of the spine by p 307 A87-52091 physiotherapy Accommodation to stimuli in peripheral vision DBIC-T-76131 p 310 N87-29108 p 307 A87-52095 THERMAL ENERGY VACUUM EFFECTS VOICE The cumulative effects of long-term exposure to low Survival under space vacuum - Biochemical aspects Levels of analysis of complex auditory stimuli levels of radiofrequency radiation (RFR) p 327 A87-53014 [AD-A182699] p 311 N87-29110 p 312 N87-30032 VASOCONSTRICTION THERMOREGULATION Variant of quantitative evaluation of mechanisms of Reaction of thermoregulatory neurons to different type: W central hemodynamic orthostatic reactions of sensory stimulation p 295 A87-51110 p 309 N87-29090 Thermal physiology of RFR interactions in animals and VECTORCARDIOGRAPHY WAKEFULNESS p 312 N87-30028 Automated analysis of vectorcardiograms in space Effectiveness of an air cooled vest using selected air Comparative characterization of the sleep-wakefulness medicine p 310 N87-29099 cycle in hibernating and nonhibernating mammals temperature, humidity and air flow rate, combinations VERTICAL ORIENTATION p 296 A87-51673 [AD-A1832981 p 326 N87-30071 Formation of spatial position image with onset of illusions THRESHOLDS (PERCEPTION) WATER of vestibular origin p 309 N87-29082 Radiation stability of organic matter in liquid and frozen Some characteristics of peripheral vision VERTICAL PERCEPTION p 306 A87-51178 H2O, NH3 and water-ammonia mixtures Subjective vertical before and after space flight p 326 A87-53003 Cortical magnification and peripheral vision p 308 A87-52999 p 307 A87-52091 The formation of amino acid precursors in the reaction **VERTIGO** Investigation of critical fusion frequency in man during of atomic carbon with water and ammonia at 77 K Spatial orientation in flight exposure to noise p 317 N87-29094 [AD-A183431] p 328 A87-53831 p 314 N87-30047 THYMUS GLAND Selective emergence and survival of early polypeptides **VESTIBULAR NYSTAGMUS** Investigation of the mechanism of thymocyte death in water p 329 A87-53839 Effects of rectilinear acceleration, caloric and optokinetic under ultrahigh gamma-ray doses p 301 A87-53538 Dielectric behaviour of water in biological material with stimulation of human subjects in the Spacelab D-1 THYROXINE particular reference to brain tissue p 313 N87-30036 p 308 A87-52998 Effect of pituitary hollow fiber units and thyroid WATER TREATMENT VESTIBULAR TESTS supplementation on growth in the little mouse (41949) Formation of spatial position image with onset of illusions Effect of cooling and freezing on microflora in water p 302 A87-53629 regenerated from atmospheric moisture condensate of vestibular origin p 309 N87-29082 TIME DEPENDENCE p 305 N87-29103 Effect of vestibular stimulation on static physical work The effect of adaptation to cold and of short-term WEADON SYSTEM MANAGEMENT capacity p 310 N87-29100 exposure to cold on the resistance of animals to hypoxic VESTIBULES Automation at the man-machine interface p 295 A87-51108 p 322 N87-29504 hypoxia The dependence of the vestibular reactions of cat Time-dependent effect of hypoxia on carotid body WEIGHTI ESSNESS cortical neurons on the duration and direction of sinusoidal p 297 A87-52220 chemosensory function Life sciences and space research XXII(2); Proceedings A87-51109 p 295 Use of task timeline analysis to assess crew workload of the Topical Meeting and Workshop 4 of the 26th Interaction of macula and semicircular canals in angular COSPAR Plenary Meeting, Toulouse, France, June 30-July p 323 N87-30056 p 314 N87-30045 stabilization of man in space TISSUES (BIOLOGY) p 297 A87-52976 VESTS Growth factor involvement in tension-induced skeletal Effectiveness of an air cooled vest using selected air Classification of gravity effects on 'free' cells muscle growth temperature, humidity and air flow rate, combinations p 297 A87-52978 p 311 N87-30025 [NASA-ČR-181349] p 326 N87-30071 The effect of microgravity on plasma-osteocalcin (AD-A1832981 Dielectric behaviour of water in biological material with p 308 A87-52994 VIBRATION EFFECTS p 313 N87-30036 particular reference to brain tissue Confirmation of gravisensitivity in the slime mold Effect of linear, impact and vibration accelerations on TITAN Physarum polycephalum under near weightlessness accuracy of operator implementation of strength load Space Station gas-grain simulation facility - Application p 300 A87-52995 programs p 316 N87-29086 to exobiology p 326 A87-53002 Cellular differentiation and proliferation in corn roots VISION TOLERANCES (PHYSIOLOGY) p 306 A87-52087 grown in microgavity (Biocosmos 1985) Cone sampling array models Afferent mechanisms of microwave-induced biological p 300 A87-52997 Estimation of local spatial scale p 316 A87-52092 effects Subjective vertical before and after space flight Review of Potegal book on spatial abilities of man [AD-A183562] p 308 A87-52999 p 305 N87-30024 p 317 N87-29106 Adjustment and validation of the mathematical prediction Execution of 'ARC' experiment on Space Shuttle An electrical circuit model of the interface between an model for sweat rate, heart rate and body temperature 'Discovery' STS 51-C - Some results on aggregation of electrode and the electrolytic medium of the cortex under outdoor conditions red blood cells under zero gravity --- Aggregation of Red [AD-A183204] p 305 N87-30023 [AD-A183109] p 314 N87-30046 p 309 A87-53620 VISUAL ACCOMMODATION blood Cells Effectiveness of an air cooled vest using selected air USSR Space Life Sciences Digest, issue 13 Improving visual performance through volitional focus temperature, humidity and air flow rate, combinations [NASA-CR-3922(15)] p 304 N87-29079 control p 306 A87-51163 [AD-A183298] p 326 N87-30071 Dynamics of fluid turnover in human extremities as Accommodation to stimuli in peripheral vision TRACE CONTAMINANTS related to different body positions p 309 N87-29088 p 307 A87-52095 A simulation model for the analysis of Space Station Symposium on space gastroenterology p 310 N87-29105 **VISUAL ACUITY** p 321 A87-53979 gas-phase trace contaminants

Does cone positional disorder limit resolution?

Cone spacing and the visual resolution limit

than radial bisection

Psychophysical estimate of extrafoveal cone spacing

Peripheral hyperacuity - Isoeccentric bisection is better

p 306 A87-52086

p 306 A87-52088

p 306 A87-52089

p 307 A87-52090

TRACKING (POSITION)

[AD-A183384]

TRACTION

concurrent discrete task

Hesitations in continuous tracking induced by a

Traction-drive, seven-degree-of-freedom telerobot arms

A concept for manipulaton in space p 323 N87-29867

Tracking a laser-projected horizon indicator

p 315 A87-51164

p 318 N87-30051

N87-29094

p 296 A87-52216

p 317

WEIGHTLESSNESS SIMULATION

WHITE NOISE

exposure to noise

hindlimb suspension in rat muscle

Structural and functional responses to prolonged

Systems interrelations of gravity responses in the human

Investigation of critical fusion frequency in man during

organism, and the use of modelling p 308 A87-53015

# WORK

Distinctions of psychosomatic correction of performance during continuous long-term work p 316 N87-29093 WORK CAPACITY

The effect of high temperature on the functional condition and work capacity of an organism

p 305 A87-50948
The problems of aircraft microclimate (Review of the literature) p 319 A87-50949

Method of enhancing interference resistance of operator performance p 317 N87-29098 Effect of vestibular stimulation on static physical work capacity p 310 N87-29100

In-flight workload assessment using embedded secondary radio communications tasks
p 323 N87-30055

Use of task timeline analysis to assess crew workload p 323 N87-30056

Measurement of pilot workload p 325 N87-30068

WORKLOADS (PSYCHOPHYSIOLOGY)

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques

omparison of fuzzy and crisp measurements techniques p 316 A87-51165 Automation at the man-machine interface

The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective workload p 322 N87-29508

Organization of displays in the visual space of the combat aircraft pilot p 322 N87-29516

The practical assessment of pilot workload

[AGARD-AG-282] p 323 N87-30054 In-flight workload assessment using embedded secondary radio communications tasks

p 323 N87-30055 Use of task timeline analysis to assess crew workload p 323 N87-30056

Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30057
The use of subjective workload assessment technique in a complex flight task p 324 N87-30058

in a complex flight task p 324 N87-30058
Workload methodology p 324 N87-30059
Mental workload measurement in operational aircraft
systems: Two promising approaches

p 318 N87-30060
Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system displays p 324 N87-30061

In-flight assessment of workload using instrument scan p 324 N87-30062

Flight test evaluation of crew workload. Part 1: Aircraft certification for a minimum crew of two pilots

p 324 N87-30063

Measurement of aircrew workload during low-level flight.

Part 1: A comparison between in-flight and post flight assessment methods

p 325 N87-30064

p 325 N87-30064

assessment methods p 325 N87-30064
In-flight assessment of workload using pilot ratings and heart rate p 315 N87-30065
The assessment of workload in helicopters

p 325 N87-30066 Assessing workload for minimum crew certification. Part

Assessing workload for minimum crew certification. Part

1: Static workload analysis and performance analysis
p 325 N87-30067

Measurement of pilot workload p 325 N87-30068

Measurement of pilot workload p 325 N87-30068 Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069



# X RAYS

Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cells

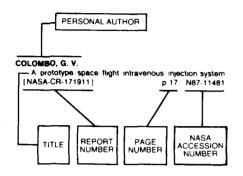
p 301 A87-53537

# PERSONAL AUTHOR INDEX

AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 305)

January 1988

# **Typical Personal Author Index Listing**



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

# ABIR, IRIT

Geotropic sensitivity exhibited by single hornets - The influence of caste, age, light and temperature

p 298 A87-52981

# ADAIR, ELEANOR R.

Thermal physiology of RFR interactions in animals and p 312 N87-30028 AHUMADA, ALBERT J., JR.

# Cone sampling array models

p 306 A87-52087 ALTUKHOV, V. G.

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory system p 306 A87-50950

# AMALBERTI, R.

Study of anticipation mechanisms in the aeronautical nvironment p 317 N87-29505 Sophisticated integral control methods for use in flight

p 322 N87-29510 Organization of displays in the visual space of the combat aircraft pilot p 322 N87-29516

# ANDREEVA. L. V.

Comparative characterization of the sleep-wakefulness cycle in hibernating and nonhibernating mammals

p 296 A87-51673

# ANDRONIKOU, S.

Time-dependent effect of hypoxia on carotid body p 297 A87-52220 chemosensory function

# ARGUELLO, CARLOS

Liposomes with polyribonucleotides as model of precellular systems p 328 A87-53835

# ARKHANGELSKIY, D. YU.

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085

Psychological control of health status during long-term exposure to longitudinal accelerations p 317 N87-29107

# ASTAPOV, IU. V.

The development of an algorithm for predicting the success of an operator's activity on the basis of a small learning sample p 315 A87-50947

# **AUGUSTINE, MARGRET**

Biosphere II - The closed ecology project [AAS PAPER 86-119] p 320 A87-53092

# AZHAEV, A. N.

The problems of aircraft microclimate (Review of the p 319 A87-50949 literature)

# AZHIMAMATOV, T. A.

Hemodynamic effects of negative pressure in lowe p 314 N87-30044 body

# B

# BAEZA, ISABEL

Liposomes with polyribonucleotides as model of precellular systems p 328 A87-53835 p 328 A87-53835 BAGROVA, N. D.

The effect of high temperature on the functional condition and work capacity of an organism

# BAKKER, C. G.

Nucleic acid-like structures. II - Polynucleotide analogues as possible primitive precursors of nucleic acids p 329 A87-53837

р 305 A87-50948

p 320 A87-52990

p 300 A87-52995

# BALTABAYEV, T. B.

Hemodynamic effects of negative pressure in lower p 314 N87-30044 hody

# BANDURSKI, ROBERT S.

Possible effects of organelle charge and density on cell p 298 A87-52983 metabolism

Search for catalytic properties of simple polypeptides p 329 A87-53840

# BARER, A. S.

Concept of functional strength in the problem of objectivization of biomechanical specifications for protective and rescue gear for aircraft crews p 321 N87-29084

# BARNARD, P.

Time-dependent effect of hypoxia on carotid body p 297 A87-52220 chemosensory function

# BAUMANN, ULRICH

Binding of DNA hairpins to an assembler-strand as part p 329 A87-53838 of a primordial translation device

Head-down tilt and restraint on renal function and p 296 A87-52215 glomerular dynamics in the rat

Dosimetric mapping inside Biorack

# BENDORAITYTE, D.

Interaction of growth-determining systems with gravity p 299 A87-52987

# BENTON, E. V.

The measured radiation environment within Spacelabs and 2 and comparison with predictions p 320 A87-52992

# BERNHARDT, JURGEN H.

Evaluation of human exposure to low frequency fields p 313 N87-30037

# BIFERNO, MICHAEL

Mental workload measurement in operational aircraft systems: Two promising approaches n 318 N87-30060

# BLACK, F. OWEN

Role of orientation reference selection in motion sickness, supplement 2S [NASA-CR-181393]

p 315 N87-30049

# BLANTZ, R. C.

Head-down tilt and restraint on renal function and p 296 A87-52215 glomerular dynamics in the rat

Classification of gravity effects on 'free' cells p 297 A87-52978 Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness

# BLOCK, ROGER F.

Automated Subsystem Control for Life Support System (ASCLSS)

### NASA-CR-172003] p 321 N87-29117 BLOMBERG, R. D.

Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067

# BLOOM, KENNETH R.

Visual input requirements relating to pursuit tracking accuracy p 318 N87-30052 FAD-A1834451

# BOGOSLOVSKII, M. M.

Comparative characterization of the sleep-wakefulness cycle in hibernating and nonhibernating mammals p 296 A87-51673

# BONDARENKO, R. A.

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085 BORISOVA, E. A. Investigation of the mechanism of thymocyte death

under ultrahigh gamma-ray doses p 301 Á87-53538 BRACK A

Search for catalytic properties of simple polypeptides p 329 A87-53840

# BRACK, ANDRE

Selective emergence and survival of early polypeptides in water p 329 A87-53839 BRAUSER, K.

The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506

# BREWER, DANA A.

A simulation model for the analysis of Space Station p 321 A87-53979 gas-phase trace contaminants BRIEGLEB. W.

Classification of gravity effects on 'free' cells

p 297 A87-52978 Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness

p 300 A87-52995 Survey of the vestibulum, and behavior of Xenopus laevis

larvae developed during a 7-days space flight p 300 A87-52996

# BROWN, ALLAN H.

The origin and evolution and comparative physiology p 298 A87-52982 of gravity sensing organs

BRYAN, CHARLES I. Species variation in lung antioxidant enzyme activities p 296 A87-52217

# BUECKER, H.

Dosimetric mapping inside Biorack

p 320 A87-52990

Embryogenesis and organogenesis of Carausius morosus under spaceflight conditions

p 299 A87-52991

# BULAYEV. YU. O.

Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086

# BURCHULADZE, T. G.

Formation of single-strand breaks in DNA under the effect of high-intensity UV radiation p 295 A87-51125 BURSTEIN, R.

Adjustment and validation of the mathematical prediction model for sweat rate, heart rate and body temperature under outdoor conditions [AD-A183109] p 314 N87-30046

# BUSH, HAROLD G.

Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118

# BUZULINA, V. P.

Functional state of the human cardiorespiratory system following 30-day antiorthostatic hypokinesia

p 309 N87-29089

# C

# CABLE, N. E.

Robot manipulators for sample handling in space p 320 A87-53921

# CAIN, S. M.

O2 delivery to contracting muscle during hypoxic or CO p 297 hypoxia A87-52222

# CAIRNS-SMITH, A. GRAHAM

Clay minerals and the origin of life

p 327 A87-53551

p 302 A87-53615

p 314 N87-30043

# **CARNEY, THOM**

CARNEY, THOM

Parallel processing of motion and colour information p 316 A87-54099

CARRETTA, THOMAS R.

Spatial ability as a predictor of flight training nerformance p 318 N87-30050 AD-A1831411

CARROLL, THOMAS W.

The design and development of a mobile transporter system for the Space Station Remote Manipulator p 323 N87-29865 System

CHATTERJEE, R. S.

Automated analysis of vectorcardiograms in space medicine p 310 N87-29099

CHERNOMORETS, V. A.

The human strategies in the formation of subjective constraints on manual-control parameters

p 319 A87-52828

CHINKIN A S

Status of Alpha 1-adrenergic regulation of stroke volume p 304 N87-29091 in hypokinetic rats

CHIZHOV. S. V.

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103

CHOU, C. K.

Afferent mechanisms of microwave-induced biological effects p 305 N87-30024

[AD-A183562]

CHRISTENSEN, JULIEN M.

Optimization of peripheral vision p 310 N87-29109

[AD-A1824381

CHUDIMOV, V. F.

Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309 N87-29090

COLETTA, NANCY J.

Psychophysical estimate of extrafoveal cone spacing p 306 A87-52088

Cone spacing and the visual resolution limit p 306 A87-52089

CONKIN JOHNNY

Empirical models for use in designing decompression

rocedures for space operations [NASA-TM-100456] p 311 N87-29114

CONLEY, G.

Space Station gas-grain simulation facility - Application to exobiology p 326 A87-53002

COSIMINI, HENRY M.

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations p 326 N87-30071 [AD-A183298]

COUCHMAN, DONALD H.

Improving visual performance through volitional focus p 306 A87-51163

# D

D'AMELIO, FERNANDO E.

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 microscopy

DANTSIG. I. N.

Investigation of critical fusion frequency in man during p 317 N87-29094 exposure to noise

DARBELLEY, N.

Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985)

p 300 A87-52997

DAUWALDER, M.

Distribution of calmodulin in corn seedlings Immunocytochemical localization in coleoptiles and p 299 A87-52986 apices

DECAMPLI, WILLIAM M.

Medical problems associated with long-duration space

[AAS PAPER 86-115] DEM'IANENKO, V. S.

p 308 A87-53090

The dependence of the vestibular reactions of cat cortical neurons on the duration and direction of sinusoidal p 295 A87-51109 rotation

DESPLANCHES, D.

Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216 DINTENEASS, L.

Execution of 'ARC' experiment on Space Shuttle 'Discovery' STS 51-C - Some results on aggregation of red blood cells under zero gravity p 309 A87-53620

Investigation of critical fusion frequency in man during exposure to noise p 317 N87-29094 DMITRIEVA, V. V.

and Algorithm program software of ลก information/measurement system for evaluating the state p 319 A87-52830 DODD, S. L.

O2 delivery to contracting muscle during hypoxic or CO hypoxia p 297 A87-52222 DOLGOV. E. G.

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to cooling p 301 A87-53534 overheating

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to cooling p 301 A87-53534 overheating DOMAGALSKI W

Possible effects of organelle charge and density on cell metabolism p 298 A87-52983

DONCHIN EMANUEL

Workload methodology p 324 N87-30059

Life sciences and space research XXII(2): Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July 11, 1986 p 297 A87-52976 Hypotheses on the appearance of life on (Review) n 326 A87-53000

Survival under space vacuum - Biochemical aspects p 327

DRESCHEL, T. W.

Porous membrane utilization in plant nutrient delivery p 297 A87-52253 [ASAE PAPER 87-0425]

DRISS-ECOLE, D.

Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985)

p 300 A87-52997

DURNEY, CARL H. Physical interactions of radiofrequency radiation fields

p 312 N87-30027 and biological systems DWORKIN, J.

Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermi

p 328 A87-53834

DYMNIKOVA. L. P. Reaction of thermoregulatory neurons to different types of sensory stimulation p 295 A87-51110

EDWARDS, BENJAMIN F.

Empirical models for use in designing decompression procedures for space operations [NASA-TM-100456] p 311 N87-29114

ELWELL, ROBERT

The assessment of workload in helicopters

p 325 N87-30066 ENCRENAZ, TH.

Search for organic molecules in the outer solar p 327 A87-53007

ENG, LAWRENCE F.

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron microscopy p 302 A87-53624 ENGE. W.

Dosimetric mapping inside Biorack

p 320 A87-52990

ENGELMAN, WILLIAM R.

Enhancement of human performance in manual target acquisition and tracking [AD-A183549] p 318 N87-30053

EPSTEIN, Y.

Adjustment and validation of the mathematical prediction model for sweat rate, heart rate and body temperature under outdoor conditions

[AD-A183109] p 314 N87-30046

EVANS, MICHAEL L.

Role of calcium in gravity perception of plant roots p 298 A87-52985

FACIUS, R.

Dosimetric mapping inside Biorack

p 320 A87-52990

Embryogenesis and organogenesis of Carausius morosus under spaceflight conditions p 299 A87-52991

FADDEN, DELMAR M.

Pilot subjective evaluation of workload during a flight p 324 N87-30057 test certification programme

FARRINGTON, MARIANNE A.

An enzyme immunoassay for rat growth hormone -Applications to the study of growth hormone variants

FAST, THOMAS N.

Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077

FEDORENKO, B. S.

Biological effectiveness of helium ions and protons of p 301 A87-53539 relativistic energies

FEDOROV, B. M.

Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest

FEDOROV, V. P.

Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540

FELDER, ROBERT P

Bacterial activity in the warmer, sulphate-bearing, Archaean oceans p 296 A87-51251

FERRIS, JAMES P. 1986 ISSOL Meeting, 5th, Berkeley, CA, July 21-25, 1986, Proceedings p 328 A87-53826

FIGUREAU A

Information theory and the genetic code

p 330 A87-53845

FINEGOLD LEONARD

Molecular aspects of adaptation to extreme cold p 327 A87-53009 FISHMAN G J.

The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992

FLANDROIS, R.

Structural and functional responses to prolonged hindlimb suspension in rat muscle p 296 A87-52216 FOLDS, DENNIS J.

Enhancement of human performance in manual target

acquisition and tracking [AD-A183549]

p 318 N87-30053 FORT. A. Assessing workload for minimum crew certification. Part

1: Static workload analysis and performance analysis p 325 N87-30067

p 325 N87-30067

p 308 A87-52221

p 307 A87-52219

p 309 N87-29080

Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis

FRANK, A. L.

The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions

p 320 A87-52992

FREY, MARY ANNE BASSETT Hysteresis in response to descending and ascending

lower-body negative pressure FRIEDMANN, E. I. The Antarctic cold desert and the search for traces of life on Mars p 327 A87-53010

**FUKUDA, TADAHIKO** 

Some characteristics of peripheral vision p 306 A87-51178

**FURIA, LUCIANO** Biological effects of millimeter-wave irradiation

p 305 N87-30022

G

GABRIEL, R. F.

[AD-A182890]

Use of task timeline analysis to assess crew workload p 323 N87-30056

GANDHI, OM P.

Biological effects of millimeter-wave irradiation AD-A1828901 p 305 N87-30022

GARSHNEK, VICTORIA

USSR Space Life Sciences Digest, issue 13 NASA-CR-3922(15)] p 304 N87-29079 GAUTIER, H.

Hypoxia and monosynaptic reflexes in humans

GAYDAMAKIN, N. A. Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087 GAZENKO, O. G.

Investigations onboard the biosatellite Cosmos-1667

p 299 A87-52989 JPRS Report: Science and technology, USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March

- April 1987 [JPRS-USB-87-004] GEDDES, NORMAN D.

The use of individual differences in inferring human operator intentions p 320 A87-53063

**B-2** 

GERASIMENKO, V. N.

Biological effectiveness of helium ions and protons of p 301 A87-53539 relativistic energies GERTH, JEFFREY M.

Enhancement of human performance in manual target

acquisition and tracking

[AD-A1835491 p 318 N87-30053 GHODGAONKAR, DEEPAK

Biological effects of millimeter-wave irradiation
[AD-A182890] p 305 N8

p 305 N87-30022 GIBBS, MICHAEL A.

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron

microscopy
GILLINGHAM, KENT K.

Spatial orientation in flight

p 314 N87-30047 [AD-A183431] GLOD, G. D.

Adaptive and cumulative effects on dogs of regular p 304 N87-29087

exposure to +Gz accelerations GOLOVLEVA, N. V. Mathematical model of pilot head kinematics during

p 321 N87-29097 ejection into air flow GORA, YE. P.

Effect of voluntary control of respiration on functional state of the cardiorespiratory system in the presence of hypoxic hypoxia p 310 N87-29102

GOROSHINSKAIA, I. A.

The effect of adaptation to cold and of short-term exposure to cold on the resistance of animals to hypoxic p 295 A87-51108

GORSKII. IU. V.

The development of an algorithm for predicting the success of an operator's activity on the basis of a p 315 A87-50947 learning sample

GRANT, EDWARD H.

Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036 GRAUL, E. H.

Embryogenesis and organogenesis of Carausius morosus under spaceflight conditions

p 299 A87-52991

p 302 A87-53624

GREBENIK, M. A.

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory p 306 A87-50950 system

GREGER, G.

Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary

p 299 A87-52988

**GRINDELAND, RICHARD** 

Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077

GRINDELAND, RICHARD E.

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949)

p 302 A87-53629

GRISHANOVICH, A. P.
Algorithm and program software of an information/measurement system for evaluating the state p 319 A87-52830 of an operator

**GU. YUANCHAO** 

Accommodation to stimuli in peripheral vision

p 307 A87-52095

GULICK, R. K.

Use of task timeline analysis to assess crew workload p 323 N87-30056

GUSEV, V. M.

Interaction of macula and semicircular canals in angular p 314 N87-30045 stabilization of man in space

Afferent mechanisms of microwave-induced biological effects

[AD-A183562] p 305 N87-30024

GYURDZHIYAN, A. A.

Review of Potegal book on spatial abilities of man p 317 N87-29106

Н

HALL, JOHN B., JR.

A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979

HANN, R. L.

The use of subjective workload assessment technique in a complex flight task p 324 N87-30058

HARKNESS, JOHN E.

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949) p 302 A87-53629 HARRIS, R. L., SR.

In-flight assessment of workload using instrument p 324 N87-30062

HART, SANDRA G.

The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective p 322 N87-29508 p 325 N87-30068 Measurement of pilot workload

HARTMAN, HYMAN

Clay minerals and the origin of life

p 327 A87-53551

HATFIELD, J. MICHAEL

Flow cytometric immunofluorescence of rat anterior p 302 A87-53619 pituitary cells

Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and perpendicular light scatter p 302 A87-53649

Flow cytometric analysis and sorting of live female rat anterior pituitary cell types by forward angle and perpendicular light scatter - Effect of 17 beta-estradiol

HENDRICKS, CURTIS

Neuromuscular and mechanical responses to inspiratory p 307 A87-52218 resistive loading during sleep HENSEL, W.

Polarity of root statocytes Relevance p 298 A87-52984 graviperception

HEYNICK, LOUIS N. Critical review of selected topics on biological effects p 312 N87-30029 of radiofrequency radiation

HILL, DOUGLAS A. Application of human whole-body RF absorption

measurements to RFR safety standards p 313 N87-30034

Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77) p 313 N87-30039

HILL, DOUGLAS W.

Biological effects of millimeter-wave irradiation p 305 N87-30022 [AD-A182890]

HINGHOFER-SZALKAY, H.

Life sciences and space research XXII(2): Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July 11, 1986 p 297 A87-52976 Systems interrelations of gravity responses in the human

organism, and the use of modelling p 308 A87-53015

Porous membrane utilization in plant nutrient deliven [ASAE PAPER 87-0425] p 297 A87-5225 p 297 A87-52253

HIRSCH, JOY Does cone positional disorder limit resolution? p 306 A87-52086

HIRSCH, P.

Microbial life at extremely low nutrient levels

p 300 A87-53012

Tracking a laser-projected horizon indicator

p 318 N87-30051 FAD-A1833841

HODGES, CARL N.

The closed ecology project - Agricultural and life sciences background p 320 A87-53093

[AAS PAPER 86-120] HOFFLER, G. WYCKLIFFE

Hysteresis in response to descending and ascending p 308 A87-52221

lower-body negative pressure

HOFMANN, KLAUS W. Radiofrequency radiation safety guidelines in the Federal

Republic of Germany p 313 N87-30038 HOLLISTER, WALTER M.

Automation at the man-machine interface

p 322 N87-29504

HOLM, NILS G.

Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828

HOOKE, LYDIA RAZRAN

USSR Space Life Sciences Digest, issue 13 NASA-CR-3922(15)] p 304 N87-29079

HORITA, A. Afferent mechanisms of microwave-induced biological

effects [AD-A183562] p 305 N87-30024

HORNECK, G.

Life sciences and space research XXII(2); Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July p 297 A87-52976 Bioscience experiments in the German Spacelab

mission D-1 - Introduction and summary p 299 A87-52988

Embryogenesis and organogenesis of Carausius morosus under spaceflight conditions D 299 A87-52991

HORRIGAN, DAVID J., JR.

Empirical models for use in designing decompression rocedures for space operations

[NASA-TM-100456] p 311 N87-29114

HUDGEL, DAVID W. Neuromuscular and mechanical responses to inspiratory resistive loading during sleep p 307 A87-52218

HYMER, W. C. An enzyme immunoassay for rat growth hormone -Applications to the study of growth hormone variants p 302 A87-53615

Flow cytometric immunofluorescence of rat anterior pituitary cells p 302 A87-53619 Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949) p 302 A87-53629

Flow cytometric analysis and sorting of live male rat anterior pituitary cell types by forward angle and perpendicular light scatter p 302 A87-53649

Flow cytometric analysis and sorting of live female rat anterior pituitary cell types by forward angle and perpendicular light scatter - Effect of 17 beta-estradiol p 302 A87-53650

ı

IBANEZ, MIGUEL

Liposomes with polyribonucleotides as model of p 328 A87-53835 precellular systems

IL'IN. E. A. Investigations onboard the biosatellite Cosmos-1667 p 299 A87-52989

IMHOFF, J. F.

Survival strategies of microorganisms in extreme saline p 300 A87-53013

INOUE, MASAO Development of a small-sized space manipulator p 319 A87-51979

ISHAY, JACOB S.

Geotropic sensitivity exhibited by single hornets - The influence of caste, age, light and temperature

ISKANDER, MAGDY F. Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N8

p 305 N87-30022 IVANOV, V. V.

Formation of spatial position image with onset of illusions p 309 N87-29082 of vestibular origin IWATA, TOSHIAKI

Development of a small-sized space manipulator p 319 A87-51979

p 298 A87-52981

JENKINS, LYLE M.

Telerobotic work system: Concept development and p 323 N87-29866

JENKINSON, STEPHEN G.

Species variation in lung antioxidant enzyme activities p 296 A87-52217

JENSEN, J. KERMIT

Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118 JONGEWARD, G. A.

Charging of a man in the wake of the shuttle [AD-A182789] p 311 N87-29111

K

KABACHENKO, A. N.

Biological effectiveness of helium ions and protons of relativistic energies p 301 A87-53539

KABESHEVA, T. A. Dynamics of fluid turnover in human extremities as related to different body positions KANAVARIOTI, ANASTASSIA p 309 N87-29088

Kinetic analysis template p 329 A87-53836 ribooligoguanylate elongation

KARMANOVA, I. G. Comparative characterization of the sleep-wakefulness

cycle in hibernating and nonhibernating mammals

KASS J. R.

Subjective vertical before and after space flight p 308 A87-52999

Charging of a man in the wake of the shuttle [AD-A182789] p 311 N87-29111 KELLY, PATRICIA A.

Hesitations in continuous tracking induced by a concurrent discrete task p 315 A87-51164 KENNEY, RICHARD A.

Hysteresis in response to descending and ascending lower-body negative pressure p 308 A87-52221

p 296 A87-51673

# KERSTEN, DANIEL

KERSTEN, DANIEL

Contrast discrimination in peripheral vision

p 307 A87-52093

KESZTHELYI, L.

Kinetics O-photointermediate bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH p 296 A87-51465

KHARCHENKO, V. I.

Mathematical model of pilot head kinematics during p 321 N87-29097 ejection into air flow

KHORISHKO, A. I.

The development of an algorithm for predicting the success of an operator's activity on the basis of a small p 315 A87-50947 learning sample

KING BARBARA

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165

KING, C. E.

O2 delivery to contracting muscle during hypoxic or CO p 297 A87-52222

KISLYAKOV, V. A.

Interaction of macula and semicircular canals in angular p 314 N87-30045 stabilization of man in space KLAPP, STUART T.

Hesitations in continuous tracking induced by p 315 A87-51164 concurrent discrete task

KLEIN, H. P.

p 326 A87-53001 Exobiology revisited

KLEIN, STANLEY A.

Peripheral hyperacuity - Isoeccentric bisection is better p 307 A87-52090 than radial bisection

Survey of the vestibulum, and behavior of Xenopus laevis

larvae developed during a 7-days space flight p 300 A87-52996

KNOTT, W. M., III

Porous membrane utilization in plant nutrient delivery

p 297 A87-52253 [ASAE PAPER 87-0425] KOCH, W.

Treatment of degenerative diseases of the spine by physiotherapy

[DRIC-T-7613] n 310 N87-29108

KÖLESINA, N. B.

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103

KOLIUBAEVA, S. N.

Investigation of the mechanism of thymocyte death under ultrahigh gamma-ray doses p 301 A87-53538 KONAGAYA, MASAAKI

A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle Studies with RU 38486, a potent and selective antiglucocorticoid p 296 A87-51151

KONAKHEVICH, YU. G.

Concept of functional strength in the problem of objectivization of biomechanical specifications for protective and rescue gear for aircraft crews

p 321 N87-29084 Mathematical model of pilot head kinematics during p 321 N87-29097

KORMACHEV, V. V.

The development of an algorithm for predicting the success of an operator's activity on the basis of a small p 315 A87-50947

learning sample KOROLEVA, I. N.

Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load p 316 N87-29086 programs

KOVALENKO, V. P.

The effect of high temperature on the functional condition and work capacity of an organism p 305 A87-50948

KRAFT, CONRAD L.

Optimization of peripheral vision

p 310 N87-29109 [AD-A182438]

KRANZ, A. R.

Genetic and physiological damage induced by cosmic radiation on dry plant seeds during space flight p 299 A87-52993

KRASNYKH, I. G.

Adaptive and cumulative effects on dogs of regular p 304 N87-29087 exposure to +Gz accelerations KRUPP, JEROME H.

Critical review of selected topics on biological effects

of radiofrequency radiation p 312 N87-30029
The cumulative effects of long-term exposure to low levels of radiofrequency radiation (RFR)

p 312 N87-30032

KRUSE, B.

Survey of the vestibulum, and behavior of Xenopus laevis larvae developed during a 7-days space flight

p 300 A87-52996

KUBAN, D. P.

Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 323 N87-29867 KUCHUK, E. M.

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of p 295 A87-51107 rats to high altitude

KUDRIASHOV, IU. B.

Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cells p 301 A87-53537

KUMMER. B.

The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights p 308 A87-53016

KUZNETSOV, V. I.

Adaptability of the rat hypokinetic heart to afterload, and p 304 N87-29092 the role of nervous regulation

Afferent mechanisms of microwave-induced biological effects p 305 N87-30024

[AD-A183562] LANG, E. W.

Physical-chemical limits for the stability p 327 A87-53008 biomolecules

LANGBEIN, DIETER

Physical parameters affecting living cells in space p 297 A87-52977

LAURINAVICIUS, R.

Interaction of growth-determining systems with gravity p 299 A87-52987

LAZCANO, ANTONIO

Liposomes with polyribonucleotides as model of recellular systems p 328 A87-53835 precellular systems

LEGGE, GORDON E.

Contrast discrimination in peripheral vision

p 307 A87-52093 Accommodation to stimuli in peripheral vision

p 307 A87-52095

LEHNERT, B. E.

Work performance evaluation using the exercising rat model

[DE87-010131] p 303 N87-29078

LENTZ, J. M.

Tracking a laser-projected horizon indicator p 318 N87-30051 [AD-A183384]

LEVI. DENNIS M.

Peripheral hyperacuity - Isoeccentric bisection is better p 307 A87-52090 than radial bisection

LICHTENBERG, BYRON K.

Human capabilities in space

[AAS PAPER 86-114] p 320 A87-53089

LIDDERDALE, I. GAVIN

Measurement of aircrew workload during low-level flight. Part 1: A comparison between in-flight and post flight p 325 N87-30064 assessment methods

LILLEY, J. R., JR.
Charging of a man in the wake of the shuttle

[AD-A182789] p 311 N87-29111

LOZHKIN, G. V.

Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of p 319 A87-52827 information

LUSHCHIKOV, E. A.

The problems of aircraft microclimate (Review of the literature) p 319 A87-50949 LYAPIN, V. A.

Mathematical model of pilot head kinematics during p 321 N87-29097 ejection into air flow

Treatment of degenerative diseases of the spine by physiotherapy DRIC-T-76131 p 310 N87-29108

MACDONALD, JOHN WILLIAM, II

Carotid body contributions to the exercise hypernea in p 311 N87-29113

MACHIDA, KAZUO

Development of a small-sized space manipulator p 319 A87-51979 MACHINSKIY, G. V.

Functional state of the human cardiorespiratory system following 30-day antiorthostatic hypokinesia

p 309 N87-29089

MALACINSKI, G. M.

Life sciences and space research XXII(2); Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July 11, 1986 p 297 A87-52976

Amphibian egg cytoplasm response to altered g-forces and gravity orientation p 297 A87-52979 Effects of gravity perturbation on developing animal p 298 A87-52980 systems

MALININ, I. D.

The problems of aircraft microclimate (Review of the literature) p 319 A87-50949

MANDELL, M. J.

Charging of a man in the wake of the shuttle p 311 N87-29111 [AD-A1827891

MANSUROV, T. A.

Changes in the cardiac rhythm and its regulation during p 300 A87-53533

MAR, A. Non-enzymatic synthesis of the coenzymes, uridine diphosphate glucose and cytidine diphosphate choline, and

other phosphorylated metabolic intermediates p 328 A87-53834

MARISHCHUK, V. L.

Scientific theoretical problems of validating the system for sociopsychological screening of flight personne p 316 N87-29081

MARRON, MICHAEL T.

RFR research projections for the future

p 312 N87-30031

MARTINEZ, IRIS The formation of amino acid precursors in the reaction

of atomic carbon with water and ammonia at 77 K

p 328 A87-53831

p 321 N87-29097

p 315 N87-30048

MARYIN, A. V.

ejection into air flow MAX. STEPHEN R.

A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle Studies with RU 38486, a potent and selective p 296 A87-51151 antiglucocorticoid

Mathematical model of pilot head kinematics during

MAYER, KATHLEEN S.

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[AD-A183837]

MAYET, M. H. Structural and functional responses to prolonged p 296 A87-52216 hindlimb suspension in rat muscle

MCCLENDON, JOHN H.

The relationship between the biosynthetic paths to the amino acids and their coding. I - The aliphatic amino acids and proline p 329 A87-53842

MCDONALD, J.

Structural elements and organization of the ancestral translational machinery p 330 A87-53844

MCKAY, C. P.

Space Station gas-grain simulation facility - Application exobiology p 326 A87-53002 to exobiology MCKAY, CHRISTOPHER P. Exobiology and future Mars missions - The search for p 327 A87-53011

Mars' earliest biosphere

MCPHERSON, DANIEL W. The formation of amino acid precursors in the reaction of atomic carbon with water and ammonia at 77 K

p 328 A87-53831

MEHLER, WILLIAM

Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility

[NASA-CR-181344] p 303 N87-29077

MEHLER, WILLIAM R.

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 microscopy

MENU, J.-P.

Study of anticipation mechanisms in the aeronautical nvironment p 317 N87-29505 environment Sophisticated integral control methods for use in flight

p 322 N87-29510 Organization of displays in the visual space of the combat p 322 N87-29516 aircraft pilot

MERKYS, A. Interaction of growth-determining systems with gravity

following 30-day antiorthostatic hypokinesia

p 299 A87-52987 MIKHAYLOV, V. M. Functional state of the human cardiorespiratory system

MIKULAS, MARTIN M., JR. Mobile remote manipulator vehicle system

[NASA-CASE-LAR-13393-1]

p 321 N87-29118

p 309 N87-29089

MILLER, STANLEY L.

Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in p 303 A87-53830 the primitive ocean Prebiotic synthesis of imidazole-4-acetaldehyde and p 328 A87-53833 histidine

MILLER, W. H.

Does cone positional disorder limit resolution? p 306 A87-52086

MIRRAKHIMOV, M. M. Hemodynamic effects of negative pressure in lower

p 314 N87-30044 hody MISEROCCHI, G.

Hypoxia and monosynaptic reflexes in humans p 307 A87-52219

MITCHELL, JOHN C. Proceedings of a Workshop on Radiofrequency Radiation Bioeffects

p 312 N87-30026 Radiofrequency radiation safety standards

p 312 N87-30030 Human exposures to radiofrequency radiation (RFR). A review of RFR accidents p 312 N87-30033 MOKASHI, A.

Time-dependent effect of hypoxia on carotid body p 297 A87-52220 chemosensory function

MORAY, NEVILLE A closed-loop causal model of workload based on a

comparison of fuzzy and crisp measurements techni n 316 A87-51165

Incompatibility of the M-1 maneuver with US Navy tactical aircraft oxygen systems

[AD-A183731] p 326 N87-30072 MORRIS, J.

Space Station gas-grain simulation facility - Application p 326 A87-53002 MUIR. HELEN C.

The assessment of workload in helicopters

p 325 N87-30066 MULHOLLAND, MARIBETH

Neuromuscular and mechanical responses to inspiratory resistive loading during sleep p 307 A87-52218 MUNDY, C. A.

Head-down tilt and restraint on renal function and p 296 A87-52215 glomerular dynamics in the rat MUZA. STEPHEN R.

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations (AD-A183298) p 326 N87-30071

# N

NAHON, M. A.

Flight simulation motion-base drive algorithms. Part 3: Pilot evaluations

p 317 N87-29116 NASANEN RISTO

Cortical magnification and peripheral vision

p 307 A87-52091 NEBELING, B.

Radiation stability of organic matter in liquid and frozen H2O, NH3 and water-ammonia mixtures

p 326 A87-53003

NECHAYEVA. E. I. Functional state of the human cardiorespiratory system

following 30-day antiorthostatic hypokinesia

p 309 N87-29089 NEFF. A. W.

Amphibian egg cytoplasm response to altered g-forces and gravity orientation p 297 A87-52979 Effects of gravity perturbation on developing animal svstems p 298 A87-52980

**NETICK, ALLAN** Hesitations in continuous tracking induced by a oncurrent discrete task p 315 A87-51164 concurrent discrete task NEUBERT, J.

Survey of the vestibulum, and behavior of Xenopus laevis larvae developed during a 7-days space flight

p 300 A87-52996

NIESSEN, J.

Nucleic acid-like structures. II - Polynucleotide analogues as possible primitive precursors of nucleic acids

p 329 A87-53837

NOVIKOV, V. G. Adaptive and cumulative effects on dogs of regular xposure to +Gz accelerations p 304 N87-29087 exposure to +Gz accelerations

# 0

# OBOZNOV, A. A.

Psychological control of health status during long-term exposure to longitudinal accelerations

p 317 N87-29107

ODONNELL, R. D.

Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system displays p 324 N87-30061 displays

ODONNELL, ROBERT D.

Optimization of peripheral vision [AD-A182438] p 310 N87-29109

OHMOTO, HIROSHI

Bacterial activity in the warmer, sulphate-bearing Archaean oceans p 296 A87-51251

OLSON, JOHN M.

Origin and evolution of photosynthetic reaction p 303 A87 53843 centers

ORO. J.

Prebiotic synthesis of imidazole-4-acetaldehyde and histidine p 328 A87-53833 Non-enzymatic synthesis of the coenzymes, uridine

diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates p 328 A87-53834

OSER. H.

Life sciences and space research XXII(2): Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July p 297 A87-52976 11. 1986

OSHIMA, TAIRO Energy metabolism of thermoacidophilic а

archaebacterium, Sulfolobus acidocaldarius p 303 A87-53841

OSMOVIITA, KARI

Cortical magnification and peripheral vision

OYAMA, JIRO

Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility [NASA-CR-181344] p 303 N87-29077

PALETS, B. L.

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085

p 325 N87-30070

p 315 N87-30049

p 307 A87-52091

PALETS, L. D. Theoretical analysis of efficacy of G suits with exposure

to continuously increasing accelerations p 321 N87-29085

PANFEROVA, N. YE.

Dynamics of fluid turnover in human extremities as related to different body positions p 309 N87-29088 PANTEV. T. P.

Changes in rat hemopolesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101

PARKER, L. E.

Dynamic task allocation for a man-machine symbiotic

[DE87-011950] PARKHOMENKO, I. M.

Cellular molecular mechanisms of the biological effect of low X-ray doses on isolated mammalian cel p 301 A87-53537

PARNELL, T. A.

The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions

p 320 A87-52992

Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985) p 300 A87-52997

PETERKA, ROBERT J.

Role of orientation reference selection in motion sickness, supplement 2S [NASA-CR-181393]

PETLYUK, V. KH.

Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097

PETRENKO, YE. T.

Method of enhancing interference resistance of operator p 317 N87-29098

performance

PETUKHOV, S. V. Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086

PIERSON, BEVERLY K.

Origin and evolution of photosynthetic reaction centers p 303 A87-53843

PIMENTAL, NANCY A.

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations [AD-A183298] p 326 N87-30071 PIN. F. G.

Dynamic task allocation for a man-machine symbiotic

[DE87-011950] PODSHIVALOV, A. A. p 325 N87-30070

Effect of vestibular stimulation on static physical work p 310 N87-29100

POIRSON, ALLEN

Cone sampling array models p 306 A87-52087 POKORSKI. M.

Time-dependent effect of hypoxia on carotid body p 297 A87-52220 chemosensory function POLEVOY, L. G.

Alcohol, emotions, stress and performance

p 316 N87-29083 POLSON, PETER

Critical review of selected topics on biological effects of radiofrequency radiation p 312 N87-30029 PONOMARENKO, V. A.

Psychological control of health status during long-term exposure to longitudinal accelerations p 317 N87-29107

POPOV, A. A.

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations p 321 N87-29085

POTEGAL, M.

Review of Potegal book on spatial abilities of man p 317 N87-29106

PRIANISHNIKOVA, E. N.

Biochemical reception and ionizing irradiation of an organism p 301 A87-53536

PRINCE, R. P. Porous membrane utilization in plant nutrient delivery

[ASAE PAPER 87-0425] p 297 A87-52253 PRUSS, G. M. Adaptability of the rat hypokinetic heart to afterload, and the role of nervous regulation p 304 N87-29092

# R

RADKE, HANS

Refinement of the eve-point-of-regard measurements vith helicopter pilots in a flight experiment

[DFVLR-FB-86-61] p 317 N87-29115 RADTKE, MIKE

USSR Space Life Sciences Digest, issue 13

[NASA-CR-3922(15)] p 304 N87-29079 RAGHUNATHAN, G.

Structural elements and organization of the ancestral translational machinery p 330 A87-53844 RAHMAN, KAZI

The formation of amino acid precursors in the reaction of atomic carbon with water and ammonia at 77 K

p 328 A87-53831

RAKHMATULLINA, V. A. Changes in the cardiac rhythm and its regulation during p 300 A87-53533 acute exposure to heat RAMACHANDRAN, V. S.

Interaction between colour and motion in human p 316 A87-54098

Automated analysis of vectorcardiograms in space p 310 N87-29099 REID, L. D.

Flight simulation motion-base drive algorithms. Part 3: Pilot evaluations

[UTIAS-319] REIN. R.

Structural elements and organization of the ancestral translational machinery p 330 A87-53844

REITZ, G. Dosimetric mapping inside Biorack

p 320 A87-52990 Embryogenesis and organogenesis of Carausius

p 317 N87-29116

morosus under spaceflight conditions p 299 A87-52991

ROESSLER, K. Radiation stability of organic matter in liquid and frozen

H2O, NH3 and water-ammonia mixtures p 326 A87-53003

ROLIK, I. S. Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087

ROMANTSEV. E. F. Biochemical reception and ionizing irradiation of an organism p 301 A87-53536

ROSCOE, ALAN H.

The practical assessment of pilot workload

p 323 N87-30054 [AGARD-AG-282] In-flight assessment of workload using pilot ratings and heart rate p 315 N87-30065

ROSCOE, STANLEY N.

Improving visual performance through volitional focus p 306 A87-51163 control

ROSENBERGER, JAMES L.

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949) p 302 A87-53629

ROSENZWEIG, EYAL

Geotropic sensitivity exhibited by single hornets - The influence of caste, age, light and temperature p 298 A87-52981

ROTSHTEIN, A. P.

The simulation of flexible activity algorithms (For the example of an operator-display system) p 319 A87-52831

ROUX, S. J.

Distribution of calmodulin in corn seedlings Immunocytochemical localization in coleoptiles and root p 299 A87-52986 apices

ROWE, JOSEPH

USSR Space Life Sciences Digest, issue 13 p 304 N87-29079 [NASA-CR-3922(15)]

RUDIK, G. M.

The effect of adaptation to cold and of short-term exposure to cold on the resistance of animals to hypoxic p 295 A87-51108 hypoxia

RUGGIERO, FRANK T.

Pilot subjective evaluation of workload during a flight p 324 N87-30057 test certification programme RUPAINIENE, O.

Interaction of growth-determining systems with gravity p 299 A87-52987

S

SAHM, P. R.

Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary

p 299 A87-52988

SAMUEL, ARTHUR G.

Levels of analysis of complex auditory stimuli [AD-A182699] p 311 N87-29110

SANTIAGO, CARLOS

Liposomes with polyribonucleotides as model of precellular systems p 328 A87-53835

SANTUCCI, G.

Sophisticated integral control methods for use in flight p 322 N87-29510

SAVCHENKO, N. IA.

Biological effectiveness of helium ions and protons of relativistic energies p 301 A87-53539

SCHATZ, A.

Survey of the vestibulum, and behavior of Xenopus laevis larvae developed during a 7-days space flight p 300 A87-52996

SCHICK, F. V.

The use of subjective workload assessment technique in a complex flight task p 324 N87-30058

SCHMIT, V. P.

A study of pilot flight information crossmonitoring performance p 322 N87-29509

SCHMITZ, G.

SCHULZE, AGA

Radiation stability of organic matter in liquid and frozen H2O, NH3 and water-ammonia mixtures p 326 A87-53003

Possible effects of organelle charge and density on cell p 298 A87-52983 metabolism

SCHWARTZ, ALAN W.

Nucleic acid-like structures. II - Polynucleotide analogues as possible primitive precursors of nucleic acids p 329 A87-53837

SCHWARTZ, D.

Space Station gas-grain simulation facility - Application p 326 A87-53002 to exobiology

SEBEKINA, T. V.

Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest

p 314 N87-30043

SEDLAK, JEFFREY M.

An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex [AD-A183204] p 305 N87-30023

SEIFERT, R.

The task taxonomy method: A basis for an expert system on human reliability p 318 N87-29506 SFILIEV. A. A.

Investigation of the mechanism of thymocyte death p 301 A87-53538 under ultrahigh gamma-ray doses SEMPORE, B.

Structural and functional responses to prolonged hindlimb suspension in rat muscle SHADLEN, MICHAEL p 296 A87-52216

Parallel processing of motion and colour information p 316 A87-54099 SHALIAPINA, V. G.

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of rats to high altitude p 295 A87-51107 SHAPIRO, Y.

Adjustment and validation of the mathematical prediction model for sweat rate, heart rate and body temperature under outdoor conditions

FAD-A1831091 p 314 N87-30046 SHAPOVOLOV, A. A.

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory p 306 A87-50950 system

SHEN, CHUN

Prebiotic synthesis of imidazole-4-acetaldehyde and histidine p 328 A87-53833

SHEVLIN, PHILIP B.

The formation of amino acid precursors in the reaction of atomic carbon with water and ammonia at 77 K p 328 A87-53831

SHIBATA, M.

Structural elements and organization of the ancestral translational machinery p 330 A87-53844

SHIKINA. M. I.

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103

SHINGLEDECKER, CLARK A.

Optimization of peripheral vision

p 310 N87-29109 [AD-A182438] In-flight workload assessment using embedded secondary radio communications tasks

p 323 N87-30055

SHOLLO, L. N.

Mathematical model of pilot head kinematics during ejection into air flow p 321 N87-29097

SIABRO, V. D.

Taking account of rules in the prediction of the possible p 319 A87-52829 strategies of active partners

SISTRUNK, FRANK

Part-task training strategies in simulated carrier landing final-approach training p 315 A87-51162 SKRYPNIKOV. A. I.

Distinctions of psychosomatic correction of performance p 316 N87-29093 during continuous long-term work SMATRESK, N.

Time-dependent effect of hypoxia on carotid body chemosensory function p 297 A87-52220

SMIRNOV, K. V.

Symposium on space gastroenterology p 310 N87-29105

SMITH, R. C.

Amphibian egg cytoplasm response to altered g-forces and gravity orientation p 297 A87-52979

Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness p 300 A87-52995

SOLOVYEVA, L. S.

Automated analysis of vectorcardiograms in space medicine p 310 N87-29099

SPASENNIKOV, V. V.

Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827

SPEYER, J. J.

Assessing workload for minimum crew certification. Part Static workload analysis and performance analysis
 p 325 N87-30067

SRINIVASAN, S.

Structural elements and organization of the ancestral translational machinery p 330 A87-53844

STAVERT, D. M.

Work performance evaluation using the exercising rat [DE87-010131] p 303 N87-29078

STAZHADZE, L. L.

Alcohol, emotions, stress and performance p 316 N87-29083

STERN, J. A.

Closing the man-machine loop: On the use of physiological measures to affect computer-controlled p 322 N87-29507 devices STOKER, C. R.

Space Station gas-grain simulation facility - Application to exobiology p 326 A87-53002 STONE. G.

Use of task timeline analysis to assess crew workload p 323 N87-30056

STRELTSOVA, YE. N.

Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

STRIBLING, ROSCOE

Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in p 303 A87-53830 the primitive ocean

STUCHLY, S. S.

Specific absorption rate distributions in a heterogeneous model of the human body at radiofrequencies [PB87-201356] p 313 N87-30040

SUTKOVOI, D. A.

Peroxidation of lipids and the concentration of alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression

p 301 A87-53535

SVEGZDIENE, D.

Interaction of growth-determining systems with gravity p 299 A87-52987

SVESHCHINSKIY, M. L.

Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions p 309 N87-29090

SWITKES, EUGENE

Parallel processing of motion and colour information p 316 A87-54099

TAKAHASI, MAKOTO

Studies on the structure of HCN oligomers

p 328 A87-53832

p 296 A87-51465

the O-photointermediate bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH

TARTER, JILL C.

Survey of earth orbital telescopes and their potential for exobiology p 327 A87-53005

TEETER, RONALD

USSR Space Life Sciences Digest, issue 13 [NASA-CR-3922(15)] p 304 N87-29079

TENCHOVA, V. B.

Changes in rat hemopolesis as a result of the combined effect of accelerations, radiation and radiation-modifying p 304 N87-29101 agents

THEISSEN, M.

Closing the man-machine loop: On the use of physiological measures to affect computer-controlled p 322 N87-29507

TIKHONCHUK, V. S.

Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of p 301 A87-53540 microwave and ionizing radiation

TIKHONOV, M. A.

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085

p 308 A87-52221

TIKHONOVA, N. E.

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of rats to high altitude p 295 A87-51107 TITUNIN, P. A.

Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions p 309 N87-29090

TODA, YOSHITUGU

Development of a small-sized space manipulator p 319 A87-51979 TOLE, J. R.

In-flight assessment of workload using instrument p 324 N87-30062 scan TOMASELLI, CLARE MARIE Hysteresis in response to descending and ascending

lower-body negative pressure TSANG, PAMELA S.

The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective p 322 N87-29508

Head-down tilt and restraint on renal function and glomerular dynamics in the rat p 296 A87-52215 TURBASOV, V. D.

Automated analysis of vectorcardiograms in space medicine p 310 N87-29099

TURKSEN, BURHAN

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165

TURNIPSEED, G. T.

Tracking a laser-projected horizon indicator [AD-A183384] p 318 p 318 N87-30051

UCKERMANN, RAINER

Refinement of the eve-point-of-regard measurements with helicopter pilots in a flight experiment

IDFVLR-FB-86-61] p 317 N87-29115

UGLOVA, N. N.

Adaptive and cumulative effects on dogs of regular

exposure to +Gz accelerations UHLENBECK, OLKE C. p 304 N87-29087

A small catalytic oligoribonucleotide

p 303 A87-54091 ULRICH, M. M. W.

The effect of microgravity on plasma-osteocalcin

p 308 A87-52994 UMEMOTO, KIMIKO

Studies on the structure of HCN oligomers

p 328 A87-53832

The activities of acid and the alkaline phosphatases in

tissues of an organism subjected to cooling or overheating p 301 A87-53534 USHAKOV, I, B.

Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540

VALOT, CL.

Study of anticipation mechanisms in the aeronautical p 317 N87-29505 environment

VANDEGRAAFF, RENE C.

Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069 VANDENBURGH, H. H.

Growth factor involvement in tension-induced skeletal

muscle growth [NASA-CR-181349] p 311 N87-30025

VARTBARONOV, R. A.

Adaptive and cumulative effects on dogs of regular xposure to +Gz accelerations p 304 N87-29087 exposure to +Gz accelerations VASILYEV, V. K.

Automated analysis of vectorcardiograms in space p 310 N87-29099

VERMEER, C.

The effect of microgravity on plasma-osteocalcin

p 308 A87-52994 VIDULICH, MICHAEL A.

The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective p 322 N87-29508 VIKHROV, N. I.

Automated analysis of vectorcardiograms in space p 310 N87-29099

VINOGRADOVA, Z. A.

Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for 6 p 304 N87-29095

VIRSU, VEIJO

Cortical magnification and peripheral vision

p 307 A87-52091 VISSCHER, J.

Nucleic acid-like structures. II - Polynucleotide analogues as possible primitive precursors of nucleic acids

p 329 A87-53837 VOGEL. H.

Subjective vertical before and after space flight

p 308 A87-52999 VON BAUMGARTEN, R.

Effects of rectilinear acceleration, caloric and optokinetic

stimulation of human subjects in the Spacelab D-1 mission p 308 A87-52998 VOROBYEV, O. A.

Formation of spatial position image with onset of illusions of vestibular origin p 309 N87-29082 VOROZHTSOVA, S. V.

Biological effectiveness of helium ions and protons of elativistic energies p 301 A87-53539 relativistic energies

WAINWRIGHT, W. A.

Flight test evaluation of crew workload, Part 1: Aircraft certification for a minimum crew of two pilots

p 324 N87-30063

WAKAGI, TAKAYOSHI Energy metabolism of а thermoacidophilic archaebacterium, Sulfolobus acidocaldarius

p 303 A87-53841

WALIGORA, JAMES M. Empirical models for use in designing decompression rocedures for space operations

[NASA-TM-100456] p 311 N87-29114 WALLSOM, RICHARD E.

Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 321 N87-29118

WATERTON, KEITH

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165

WATSON, ANDREW B.

p 316 A87-52092 Estimation of local spatial scale WATTS, J. W., JR.

The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992

WENDIGGENSEN, KLAUS

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment [DFVLR-FB-86-61] p 317 N87-29115

WFTZIG .I

Effects of rectilinear acceleration, caloric and optokinetic stimulation of human subjects in the Spacelab D-1 p 308 A87-52998 mission

WHITE, DAVID H.

Kinetic analysis of the template effect ribooligoguanylate elongation p 329 A87-53836 WHITE, J. T.

Incompatibility of the M-1 maneuver with US Navy tactical aircraft oxygen systems p 326 N87-30072

[AD-A183731] WICKENS, CHRISTOPHER D.

Workload methodology p 324 N87-30059

WIGHTMAN, DENNIS C.

Part-task training strategies in simulated carrier landing p 315 A87-51162 final-approach training WILLER, J. C.

Hypoxia and monosynaptic reflexes in humans

p 307 A87-52219

WILLIAMS, D. M.

Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 323 N87-29867 WILLIAMS, DAVID R.

Psychophysical estimate of extrafoveal cone spacing

p 306 A87-52088

Cone spacing and the visual resolution limit p 306 A87-52089

WILLIAMSON, GARY

Optimization of peripheral vision (AD-A1824381 p 310 N87-29109

WILSON, G. F.

Closing the man-machine loop: On the use of physiological measures to affect computer-controlled devices p 322 N87-29507

Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system displays p 324 N87-30061

WOHLFARTH-BOTTERMANN, K. E.

Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness p 300 A87-52995

WOLFE, JAMES W. Spatial orientation in flight

[AD-A183431] p 314 N87-30047

WOLTERING, AUGUSTINUS B.

Exposure to radiofrequency fields in the Netherlands: Measurements and evaluation p 313 N87-30035

WRIGHT, M. J.

Spatiotemporal properties of grating motion detection in the center and the periphery of the visual field

p 307 A87-52094

WIL JANG-YEN

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron microscopy p 302 A87-53624

YAMADA, KATSUHIKO

Development of a small-sized space manipulator p 319 A87-51979

YANG, LILY

Prebiotic synthesis of imidazole-4-acetaldehyde and p 328 A87-53833 YAP. YEN L

Peripheral hyperacuity - Isoeccentric bisection is better than radial bisection p 307 A87-52090

YEPISHKIN, A. K.

Distinctions of psychosomatic correction of performance during continuous long-term work p 316 N87-29093 p 316 N87-29093 YERMÜKHAMETOVA, L. A.

Method of enhancing interference resistance of operator performance p 317 N87-29098 YEVDOKIMOV, V. I.

Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel p 316 N87-29081

Evaluation of psychological fitness for flight work p 310 N87-29104

YOKOTA, KATSUYUKI

Studies on the structure of HCN oligomers

p 328 A87-53832

Z

ZEROV. S. F.

Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309 N87-29090

ZHIVOTOVSKII, B. D.

Investigation of the mechanism of thymocyte death under ultrahigh gamma-ray doses p 301 A87-53538 ZHUKOV, D. A.

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization p 295 A87-51106

ZIEGLER, M. G.

Head-down tilt and restraint on renal function and glomerular dynamics in the rat p 296 A87-52215 ZVONAREVA, N. B.

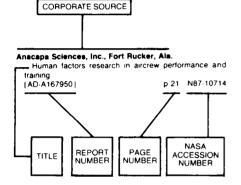
Investigation of the mechanism of thymocyte death under ultrahigh gamma-ray doses p 301 A87-53538 ZWICK, HARRY

Visual input requirements relating to pursuit tracking accuracy [AD-A1834451 p 318 N87-30052

# CORPORATE SOURCE INDEX

# AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 305)

# **Typical Corporate Source** Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

The practical assessment of pilot workload p 323 N87-30054 [AGARD-AG-282] Aerospace Research Labs., Wright-Patterson AFB,

# Cortical evoked response and eveblink measures in the

workload evaluation of alternative landing system p 324 N87-30061 displays

Air Force Human Resources Lab., Brooks AFB, Tex. Spatial ability as a predictor of flight training

[AD-A183141] p 318 N87-30050

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
An electrical circuit model of the interface between an electrode and the electrolytic medium of the cortex p 305 N87-30023 [AD-A1832041

Airbus Industrie, Blagnac (France). Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067

Army Research Inst. of Environmental Medicine. Natick, Mass.

Effectiveness of an air cooled vest using selected air temperature, humidity and air flow rate, combinations [AD-A183298] p 326 N87-30071

# B

# Bionetics Corp., Cocoa Beach, Fla

Hysteresis in response to descending and ascending lower-body negative pressure p 308 A87-52221 Porous membrane utilization in plant nutrient delivery [ASAE PAPER 87-0425] p 297 A87-52253

Boeing Co., Seattle, Wash.

Pilot subjective evaluation of workload during a flight test certification programme p 324 N87-30057

# Britannia Airways Ltd., Luton (England).

In-flight assessment of workload using pilot ratings and heart rate p 315 N87-30065 British Aerospace Dynamics Group, Hatfield (England).

Flight test evaluation of crew workload. Part 1: Aircraft certification for a minimum crew of two pilots p 324 N87-30063

# Brown Univ., Providence, R. I.

Growth factor involvement in tension-induced skeletal muscle growth

p 311 N87-30025 [NASA-CR-181349] Bundesgesundheitsamt, Neuherberg (West Germany). Evaluation of human exposure to low frequency fields

# C

# California State Univ., Hayward.

Hesitations in continuous tracking induced by a concurrent discrete task p 315 A87-51164 California Univ., Berkeley.

Survey of earth orbital telescopes and their potential p 327 A87-53005 for exobiology

California Univ., La Jolla.

Energy yields for hydrogen cyanide and formaldehyde syntheses - The HCN and amino acid concentrations in the primitive ocean p 303 A87-53830 Prebiotic synthesis of imidazole-4-acetaldehyde and histidine p 328 A87-53833

# California Univ., Los Angeles.

Carotid body contributions to the exercise hypernea in p 311 N87-29113 Centre d'Etudes et de Recherches de Medecine

# Aerospatiale, Paris (France).

Study of anticipation mechanisms in the aeronautical environment p 317 N87-29505 Sophisticated integral control methods for use in flight p 322 N87-29510

Organization of displays in the visual space of the combat p 322 N87-29516 aircraft pilot

### Centre de Recherches de Medecine Aeronautique Paris (France).

# Assessing workload for minimum crew certification. Part

1: Static workload analysis and performance analys p.325 N87-30067

# Colorado Univ., Boulder.

Space Station gas-grain simulation facility - Application to exobiology p 326 A87-53002 Cranfield Inst. of Tech., Bedford (England).

The assessment of workload in helicopters

p 325 N87-30066

# D

# Defence Research Establishment, Ottawa, (Ontario). Application of human whole-body RF absorption urements to RFR safety standards

p 313 N87-30034 Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77)

# p 313 N87-30039 Defence Research Information Centre, Orpington

(England).
Treatment of degenerative diseases of the spine by hysiotherapy IDRIC-T-76131

# p 310 N87-29108 Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Brunswick (West Germany).

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment [DFVLR-FB-86-61] p 317 N87-29115

# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

The use of subjective workload assessment technique in a complex flight task p 324 N87-30058 Douglas Aircraft Co., Inc., Long Beach, Calif. Use of task timeline analysis to assess crew workload

# p 323 N87-30056

# Drexel Univ., Philadelphia, Pa.

Molecular aspects of adaptation to extreme cold environments p 327 A87-53009

# Dunlap and Associates, Inc., Norwalk, Conn.

Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067

# E

# Ergometrics Technology, Inc., Dayton, Ohio.

In-flight workload assessment using embedded secondary radio communications tasks

p 323 N87-30055 Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system displays p 324 N87-30061

# Florida State Univ., Tallahassee.

The Antarctic cold desert and the search for traces of e on Mars p 327 A87-53010 life on Mars

# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

Radiofrequency radiation safety guidelines in the Federal Republic of Germany p 313 N87-30038

# G

# George Washington Univ., Washington, D.C.

Hysteresis in response to descending and ascending lower-body negative pressure p 308 A87-52221

Georgia Inst. of Tech., Atlanta

Enhancement of human performance in manual target equisition and tracking [AD-A183549] p 318 N87-30053

# Good Samaritan Hospital and Medical Center,

Portland, Oreg.

Role of orientation reference selection in motion sickness, supplement 2S [NASA-CR-181393] p 315 N87-30049

# Honeywell, Inc., Clearwater, Fla.

Automated Subsystem Control for Life Support System (ASCLSS)

[NASA-CR-1720031 Houston Univ., Tex.

p 321 N87-29117

Prebiotic synthesis of imidazole-4-acetaldehyde and p 328 A87-53833 histidine Non-enzymatic synthesis of the coenzymes, uridine

diphosphate glucose and cytidine diphosphate choline, and other phosphorylated metabolic intermediates

p 328 A87-53834

# Illinois Univ., Urbana-Champaign. Workload methodology

p 324 N87-30059

Indiana Univ., Bloomington.

Amphibian egg cytoplasm response to altered g-forces and gravity orientation p 297 A87-52979 Effects of gravity perturbation on developing animal p 298 A87-52980

Instituto Politecnico Nacional, Mexico City.

Liposomes with polyribonucleotides as model of precellular systems p 328 A87-53835

# Joint Publications Research Service, Arlington, Va.

JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March

[JPRS-USB-87-004]

p 309 N87-29080 Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel

p 316 N87-29081

Formation of spatial position	image with ons	et of illusions
of vestibular origin	p 309	N87-29082

Alcohol, emotions, stress and performance

p 316 N87-29083

Concept of functional strength in the problem of objectivization of biomechanical specifications for protective and rescue gear for aircraft crews

p 321 N87-29084

Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085

Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load p 316 N87-29086 programs

Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087

Dynamics of fluid turnover in human extremities as p 309 N87-29088 related to different body positions Functional state of the human cardiorespiratory system following 30-day antiorthostatic hypokinesia

p 309 N87-29089 Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309 N87-29090 Status of Alpha 1-adrenergic regulation of stroke volume

in hypokinetic rats p 304 N87-29091 Adaptability of the rat hypokinetic heart to afterload, and the role of nervous regulation p 304 N87-29092

Distinctions of psychosomatic correction of performance p 316 N87-29093 during continuous long-term work Investigation of critical fusion frequency in man during p 317 N87-29094 exposure to noise

Dynamics of noncollagen protein metabolism in dogs exposed to low doses of chronic gamma radiation for 6

p 304 N87-29095 Mathematical model of pilot head kinematics during p 321 N87-29097 ejection into air flow

Method of enhancing interference resistance of operator p 317 N87-29098 performance Automated analysis of vectorcardiograms in space

p 310 N87-29099 medicine Effect of vestibular stimulation on static physical work

p 310 N87-29100 capacity Changes in rat hemopolesis as a result of the combined

effect of accelerations, radiation and radiation-modifying p 304 N87-29101 Effect of voluntary control of respiration on functional

state of the cardiorespiratory system in the presence of p 310 N87-29102 hypoxic hypoxia

Effect of cooling and freezing on microflora in water regenerated from atmospheric moisture condensate p 305 N87-29103

Evaluation of psychological fitness for flight work p 310 N87-29104

Symposium on space gastroenterology p 310 N87-29105

Review of Potegal book on spatial abilities of man p 317 N87-29106

Psychological control of health status during long-term exposure to longitudinal accelerations

p 317 N87-29107 USSR Report: Life Sciences. Biomedical and behavioral sciences

[JPRS-UBB-87-009] p 314 N87-30042 Circulatory changes in carotid artery basin in response

to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

Hemodynamic effects of negative pressure in lower p 314 N87-30044 body

Interaction of macula and semicircular canals in angular p 314 N87-30045 stabilization of man in space

# Laboratory for Electronic Development of the Armed Forces, Oegstgeest (Netherlands).

Exposure to radiofrequency fields in the Netherlands: p 313 N87-30035 Measurements and evaluation

# Letterman Army Inst. of Research, San Francisco, Calif.

Visual input requirements relating to pursuit tracking accuracy p 318 N87-30052 [AD-A183445]

London Univ. (England).

Dielectric behaviour of water in biological material with p 313 N87-30036 particular reference to brain tissue Los Alamos National Lab., N. Mex.

Work performance evaluation using the exercising rat p 303 N87-29078

[DE87-0101311

# М

# Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn. Traction-drive, seven-degree-of-freedom telerobot arm

A concept for manipulation in space p 323 N87-29867 Maryland Univ., Baltimore.

A possible role for endogenous glucocorticoids in orchiectomy-induced atrophy of the rat levator ani muscle Studies with RU 38486, a potent and selective antiglucocorticoid p 296 A87-51151

# Massachusetts Inst. of Tech., Cambridge.

Automation at the man-machine interface p 322 N87-29504

McDonnell-Douglas Corp., Long Beach, Calif.

Mental workload measurement in operational aircraft systems: Two promising approaches p 318 N87-30060

serschmitt-Boelkow-Blohm G.m.b.H., Munich (West

Germany). The task taxonomy method: A basis for an expert system

on human reliability p 318 N87-29506 Michigan State Univ., East Lansing.

Possible effects of organelle charge and density on cell

metabolism p 298 A87-52983 Ministry of Defence, Tel-Aviv (Israel).

Adjustment and validation of the mathematical prediction model for sweat rate, heart rate and body temperature under outdoor conditions [AD-A183109]

p 314 N87-30046

# National Aeronautics and Space Administration

Washington, D.C.

Aerospace medicine and biology: bibliography with indexes (supplement 302) [NASA-SP-7011(302)] p 314 N87-30041

National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

p 306 A87-52087 Cone sampling array models p 316 A87-52092 Estimation of local spatial scale Space Station gas-grain simulation facility - Application to exobiology p 326 A87-53002

Exobiology and future Mars missions - The search for p 327 A87-53011 Mars' earliest biosphere Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 microscopy

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949)

p 302 A87-53629 effect analysis template Kinetic of the ribooligoguanylate elongation p 329 A87-53836

The effects of display-control I/O, compatibility, and integrality on dual-task performance and subjective p 322 N87-29508 workload

p 325 N87-30068 Measurement of pilot workload National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

Hysteresis in response to descending and ascending p 308 A87-52221 lower-body negative pressure Porous membrane utilization in plant nutrient delivery (ASAE PAPER 87-04251 p 297 A87-52253

National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

Empirical models for use in designing decompression procedures for space operations p 311 N87-29114 [NASA-TM-100456]

Telerobotic work system: Concept development and p 323 N87-29866 evolution

# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A simulation model for the analysis of Space Station gas-phase trace contaminants p 321 A87-53979 Mobile remote manipulator vehicle system

p 321 N87-29118 [NASA-CASE-LAR-13393-1] In-flight assessment of workload using instrument p 324 N87-30062

# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions p 320 A87-52992

National Aerospace Lab., Amsterdam (Netherlands). Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069

# National Aerospace Medical Centre, Soesterberg (Netherlands).

Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112

# Naval Aerospace Medical Research Lab., Pensacola,

Naval Aerospace Medical Research Laboratory bibliography, 1981-1986 p 315 N87-30048 [AD-A183837]

Tracking a laser-projected horizon indicator

p 318 N87-30051 [AD-A183384] Incompatibility of the M-1 maneuver with US Navy actical aircraft oxygen systems [AD-A183731] p 326 N87-30072

Nijmegen Univ. (Netherlands).

Nucleic acid-like structures. II - Polynucleotide analogues as possible primitive precursors of nucleic acids

p 329 A87-53837

# O

# Oak Ridge National Lab., Tenn.

Dynamic task allocation for a man-machine symbiotic system

[DE87-011950] p 325 N87-30070 Office of Naval Research, Arlington, Va.

RFR research projections for the future

p 312 N87-30031

Ohio State Univ., Columbus.

Role of calcium in gravity perception of plant roots p 298 A87-52985

Ottawa Univ. (Ontario).

Specific absorption rate distributions in a heterogeneous model of the human body at radiofrequencies [PB87-201356] p 313 N87-30040

# Pennsylvania State Univ., Hershey.

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron p 302 A87-53624 microscopy

Pennsylvania State Univ., University Park.

An enzyme immunoassay for rat growth hormone Applications to the study of growth hormone variants

p 302 A87-53615 Flow cytometric immunofluorescence of rat anterior p 302 A87-53619

Effect of pituitary hollow fiber units and thyroid supplementation on growth in the little mouse (41949) p 302 A87-53629

# RCA Government Services, Washington, D.C.

USSR Space Life Sciences Digest, issue 13 [NASA-CR-3922(15)] p 304 N87-29079

Rockwell International Corp., Downey, Calif. The design and development of a mobile transporter system for the Space Station Remote Manipulator

p 323 N87-29865 Roswell Park Memorial Inst., Buffalo, N. Y.

Structural elements and organization of the ancestral

translational machinery p 330 A87-53844 Royal Air Force, London (England). A study of pilot flight information crossmonitoring

p 322 N87-29509 Royal Air Force Strike Command, High Wycombe (England).

Measurement of aircrew workload during low-level flight. Part 1: A comparison between in-flight and post flight assessment methods p 325 N87-30064

S

San Francisco Univ., Calif.

The measured radiation environment within Spacelabs 1 and 2 and comparison with predictions

p 320 A87-52992 Santa Clara Univ., Calif.

Kinetic analysis of the template effect ribooligoguanylate elongation p 329 A87-53836 Growth hormone secretion during space flight and evaluation of the physiological responses of animals held in the research animal holding facility

[NASA-CR-181344] p 303 N87-29077

School of Aerospace Medicine, Brooks AFB, Tex. Proceedings of a Workshop Radiation Bioeffects on Radiofrequency

[AD-A157090] p 312 N87-30026 Critical review of selected topics on biological effects p 312 N87-30029 of radiofrequency radiation Radiofrequency radiation safety standards

p 312 N87-30030

CORPORATE SOURCE Yale Univ., New Haven, Conn.

The cumulative effects of long-term exposure to low levels of radiofrequency radiation (RFR)

p 312 N87-30032 Human exposures to radiofrequency radiation (RFR). A sview of RFR accidents p 312 N87-30033 review of RFR accidents Spatial orientation in flight

p 314 N87-30047 [AD-A183431] Search for Extraterrestrial Intelligence Inst., Los Altos, Calif.

Space Station gas-grain simulation facility - Application exobiology p 326 A87-53002 to exobiology Survey of earth orbital telescopes and their potential p 327 A87-53005 for exobiology

Stanford Univ., Calif. p 306 A87-52087

Cone sampling array models p 306 A8 Systems Science and Software, La Jolla, Calif. Charging of a man in the wake of the shuttle [AD-A182789] p 311 N87-29111

# T

# Texas Univ., Austin.

Distribution of calmodulin in corn seedlings Immunocytochemical localization in coleoptiles and root p 299 A87-52986 apices

Toronto Univ. (Ontario).

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements techniques p 316 A87-51165 Flight simulation motion-base drive algorithms. Part 3: Pilot evaluations [UTIAS-319] p 317 N87-29116

# Universal Energy Systems, Inc., Dayton, Ohio,

Optimization of peripheral vision [AD-A182438] p 310 N87-29109

Utah Univ., Salt Lake City.

Biological effects of millimeter-wave irradiation [AD-A182890] p 305 N8 AD-A182890] p 305 N87-30022 Physical interactions of radiofrequency radiation fields and biological systems p 312 N87-30027

# Veterans Administration Hospital, Palo Alto, Calif.

Immunocytochemical localization of glutamic acid decarboxylase (GAD) and glutamine synthetase (GS) in the area postrema of the cat. Light and electron microscopy p 302 A87-53624

Vigyan Research Associates, Inc., Hampton, Va.
A simulation model for the analysis of Space Station

gas-phase trace contaminants p 321 A87-53979

# Washington Univ., Seattle.

Afferent mechanisms of microwave-induced biological effects

[AD-A183562] p 305 N87-30024

# Washington Univ., St. Louis, Mo. Closing the man-machine loop: On the use of

physiological measures to affect computer-controlled p 322 N87-29507

# Yale Univ., New Haven, Conn.

Levels of analysis of complex auditory stimuli
[AD-A182699] p 311 N

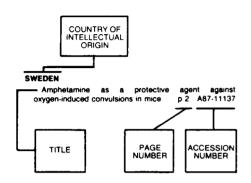
p 311 N87-29110 Thermal physiology of RFR interactions in animals and humans p 312 N87-30028

January 1988

# **FOREIGN TECHNOLOGY INDEX**

# AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 305)

# Typical Foreign Technology Index Listina



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section

# AUSTRALIA

Execution of 'ARC' experiment on Space Shuttle 'Discovery' STS 51-C - Some results on aggregation of red blood cells under zero gravity p 309 A87-53620 red blood cells under zero gravity

Systems interrelations of gravity responses in the human organism, and the use of modelling p 308 A87-53015

# CANADA

A closed-loop causal model of workload based on a comparison of fuzzy and crisp measurements technique: p 316 A87-51165

Flight simulation motion-base drive algorithms. Part 3: Pilot evaluations [UTIAS-319] p 317 N87-29116

Application of human whole-body RF absorption measurements to RFR safety standards

p 313 N87-30034

Radiofrequency radiation safety of two manpack transceivers (AN/PRC-515 and AN/PRC-77)

p 313 N87-30039 Specific absorption rate distributions in a heterogeneous

model of the human body at radiofrequencie p 313 N87-30040 [PB87-201356]

# D

# DENMARK

Origin evolution of photosynthetic reaction and p 303 A87-53843

### **FINLAND**

Cortical magnification and peripheral vision

p 307 A87-52091

FRANCE Structural and functional responses to prolonged p 296 A87-52216 hindlimb suspension in rat muscle Hypoxia and monosynaptic reflexes in humans

p 307 A87-52219 Cellular differentiation and proliferation in corn roots grown in microgavity (Biocosmos 1985)

p 300 A87-52997 Search for organic molecules in the outer solar system n 327 A87-53007 Selective emergence and survival of early polypeptides

p 329 Search for catalytic properties of simple polypeptides A87-53840 p 329

Information theory and the genetic code p 330

A87-53845 Study of anticipation mechanisms in the aeronautical p 317 N87-29505 Sophisticated integral control methods for use in flight p 322 N87-29510

Organization of displays in the visual space of the combat p 322 N87-29516 aircraft pilot The practical assessment of pilot workload

[AGARD-AG-282] p 323 N87-30054 Assessing workload for minimum crew certification. Part 1: Static workload analysis and performance analysis p 325 N87-30067

# G

# GERMANY FEDERAL REPUBLIC OF

Physical parameters affecting living cells in space p 297 A87-52977 Classification of gravity effects on 'free' cells p 297 A87-52978

Relevance Polarity of root statocytes graviperception n 298 A87-52984 Bioscience experiments in the German Spacelab mission D-1 - Introduction and summary

p 299 A87-52988 Dosimetric mapping inside Biorack

p 320 A87-52990 Embryogenesis and organogenesis of Carausius under spaceflight conditions

p 299 A87-52991 Genetic and physiological damage induced by cosmic

radiation on dry plant seeds during space flight p 299 A87-52993

Confirmation of gravisensitivity in the slime mold Physarum polycephalum under near weightlessness

p 300 A87-52995 Survey of the vestibulum, and behavior of Xenopus laevis

larvae developed during a 7-days space flight p 300 A87-52996

Effects of rectilinear acceleration, caloric and optokinetic stimulation of human subjects in the Spacelab D-1 p 308 A87-52998

Subjective vertical before and after space flight p 308 A87-52999

Hypotheses on the appearance of life on earth p 326 A87-53000 Radiation stability of organic matter in liquid and frozen H2O, NH3 and water-ammonia mixtures

p 326 A87-53003 Physical-chemical the stability of p 327 A87-53008 limits biomolecules Microbial life at extremely low nutrient levels

p 300 A87-53012 Survival strategies of microorganisms in extreme saline environments

p 300 A87-53013 Survival under space vacuum - Biochemical aspects p 327 A87-53014

The musculo-skeletal system in man - Development structure and function in dependence on gravity, and potential limitations for long term space flights

p 308 A87-53016

Binding of DNA hairpins to an assembler-strand as part p 329 A87-53838 of a primordial translation device Treatment of degenerative diseases of the spine by physiotherapy [DRIC-T-7613] p 310 N87-29108

Refinement of the eye-point-of-regard measurements with helicopter pilots in a flight experiment

p 317 N87-29115 [DFVLR-FB-86-61] The task taxonomy method: A basis for an expert system p 318 N87-29506 on human reliability Evaluation of human exposure low frequency fields

p 313 N87-30037 Radiofrequency radiation safety guidelines in the Federal Republic of Germany p 313 N87-30038

The use of subjective workload assessment technique p 324 N87-30058 in a complex flight task

# Н

### HUNGARY

the O-photointermediate Kinetics of bacteriorhodopsin photocycle in native and enzyme treated purple membrane fragments as a function of pH p 296 A87-51465

# INTERNATIONAL ORGANIZATION

Robot manipulators for sample handling in space p 320 A87-53921

Geotropic sensitivity exhibited by single hornets - The influence of caste, age, light and temperature

p 298 A87-52981 Adjustment and validation of the mathematical prediction

model for sweat rate, heart rate and body temperature under outdoor conditions [AD-A1831091 p 314 N87-30046

Some characteristics of peripheral vision

p 306 A87-51178 Development of a small-sized space manipulator A87-51979 p 319

Studies on the structure of HCN oligomers р 328 A87-53832

Energy metabolism of thermoacidophilic archaebacterium, Sulfolobus acidocaldarius

p 303 A87-53841

# LITHUANIA

Interaction of growth-determining systems with gravity p 299 A87-52987

# М

Liposomes with polyribonucleotides as model of p 328 A87-53835 precellular systems

The effect of microgravity on plasma-osteocalcin

p 308 A87-52994 Nucleic acid-like structures. II - Polynucleotide analogues as possible primitive precursors of nucleic acids

p 329 A87-53837

Activities report in aerospace medicine [ETN-87-90153] p 311 N87-29112 Exposure to radiofrequency fields in the Netherlands: Measurements and evaluation p 313 N87-30035

Investigation of workload measuring techniques: A theoretical and practical framework p 325 N87-30069 S

### SWEDEN

Possible biological origin of banded iron-formations from hydrothermal solutions p 302 A87-53828

L

### U.S.S.R.

The development of an algorithm for predicting the success of an operator's activity on the basis of a small learning sample p 315 A87-50947

The effect of high temperature on the functional condition and work capacity of an organism

The effect of elevated oxygen and carbon dioxide contents in air on the condition of the cardiorespiratory system p 306 A87-50950

Changes in binding by the corticosterone receptors in different brain structures of rats under immobilization stress p 295 A87-51106

The hormonal function of the insulin apparatus and the insulin-binding capacity of erythrocytes in adaptation of rats to high altitude p 295 A87-51107

The effect of adaptation to cold and of short-term exposure to cold on the resistance of animals to hypoxic hypoxia p 295 A87-51108

nypoxia p 295 A87-51108

The dependence of the vestibular reactions of cat cortical neurons on the duration and direction of sinusoidal rotation p 295 A87-51109

Reaction of thermoregulatory neurons to different types of sensory stimulation p 295 A87-51110 Formation of single-strand breaks in DNA under the

effect of high-intensity UV radiation p 295 A87-51125 Comparative characterization of the sleep-wakefulness cycle in hibernating and nonhibernating mammals

Estimating the operational quality of man-machine systems with bimodal and monomodal presentation of information p 319 A87-52827

The human strategies in the formation of subjective constraints on manual-control parameters

p 319 A87-52828

Taking account of rules in the prediction of the possible strategies of active partners p 319 A87-52829 Algorithm and program software of an information/measurement system for evaluating the state of an operator p 319 A87-52830

The simulation of flexible activity algorithms (For the example of an operator-display system)

p 319 A87-52831 Investigations onboard the biosatellite Cosmos-1667

p 299 A87-52989
Changes in the cardiac rhythm and its regulation during acute exposure to heat p 300 A87-53533

The activities of acid and the alkaline phosphatases in tissues of an organism subjected to cooling or overheating p 301 A87-53534 Peroxidation of lipids and the concentration of

Peroxidation of lipids and the concentration of alpha-tocopherols in the blood of rabbits adapted to hypoxia and subjected to acute decompression

p 301 A87-53535

Biochemical reception and ionizing irradiation of an organism p 301 A87-53536

Cellular molecular mechanisms of the biological effect

of low X-ray doses on isolated mammalian cells
p 301 A87-53537

Investigation of the mechanism of thymocyte death under ultrahigh gamma-ray doses p 301 A87-53538 Biological effectiveness of helium ions and protons of relativistic energies p 301 A87-53539

Analyzing the structural and metabolic reactions of the central nervous system to the combined effects of microwave and ionizing radiation p 301 A87-53540 JPRS Report: Science and technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 2, March - April 1987

[JPRS-USB-87-004] p 309 N87-29080 Scientific theoretical problems of validating the system for sociopsychological screening of flight personnel

p 316 N87-29081
Formation of spatial position image with onset of illusions of vestibular origin p 309 N87-29082
Alcohol, emotions, stress and performance

p 316 N87-29083
Concept of functional strength in the problem of objectivization of biomechanical specifications for protective and rescue gear for aircraft crews

p 321 N87-29084
Theoretical analysis of efficacy of G suits with exposure to continuously increasing accelerations

p 321 N87-29085

Effect of linear, impact and vibration accelerations on accuracy of operator implementation of strength load programs p 316 N87-29086 Adaptive and cumulative effects on dogs of regular exposure to +Gz accelerations p 304 N87-29087 Dynamics of fluid turnover in human extremities as related to different body positions p 309 N87-29088 Functional state of the human cardiorespiratory system following 30-day antiorthostatic hypokinesia

p 309 N87-29089 Variant of quantitative evaluation of mechanisms of central hemodynamic orthostatic reactions

p 309 N87-29090
Status of Alpha 1-adrenergic regulation of stroke volume in hypokinetic rats p 304 N87-29091
Adaptability of the rat hypokinetic heart to afterload, and the role of nervous regulation p 304 N87-29092
Distinctions of psychosomatic correction of performance during continuous long-term work p 316 N87-29093

during continuous long-term work p 316 N87-29093 Investigation of critical fusion frequency in man during exposure to noise p 317 N87-29094 Dynamics of noncollagen protein metabolism in dogs

exposed to low doses of chronic gamma radiation for 6 years p 304 N87-29095
Mathematical model of pilot head kinematics during

ejection into air flow p 321 N67-29097 Method of enhancing interference resistance of operator performance p 317 N87-29098 Automated analysis of vectorcardiograms in space

medicine p 310 N87-29099
Effect of vestibular stimulation on static physical work capacity p 310 N87-29100

Changes in rat hemopolesis as a result of the combined effect of accelerations, radiation and radiation-modifying agents p 304 N87-29101

Effect of voluntary control of respiration on functional state of the cardiorespiratory system in the presence of hypoxic hypoxia p 310 N87-29102 Effect of cooling and freezing on microflora in water

regenerated from atmospheric moisture condensate p 305 N87-29103

Evaluation of psychological fitness for flight work

p 310 N87-29104 Symposium on space gastroenterology

p 310 N87-29105 Review of Potegal book on spatial abilities of man

p 317 N87-29106
Psychological control of health status during long-term exposure to longitudinal accelerations

p 317 N87-29107 USSR Report: Life Sciences, Biomedical and behavioral

sciences
[JPRS-UBB-87-009] p 314 N87-30042
Circulatory changes in carotid artery basin in response

Circulatory changes in carotid artery basin in response to antiorthostasis and antiorthostatic bed rest p 314 N87-30043

Hemodynamic effects of negative pressure in lower body p 314 N87-30044 Interaction of macula and semicircular canals in angular stabilization of man in space p 314 N87-30045 UNITED KINGDOM

Spatiotemporal properties of grating motion detection in the center and the periphery of the visual field

p 307 A87-52094 Life sciences and space research XXII(2); Proceedings of the Topical Meeting and Workshop 4 of the 26th COSPAR Plenary Meeting, Toulouse, France, June 30-July 11, 1986 p 297 A87-52976

Clay minerals and the origin of life

p 327 A87-53551 A study of pilot flight information crossmonitoring performance p 322 N87-29509 Dielectric behaviour of water in biological material with

Dielectric behaviour of water in biological material with particular reference to brain tissue p 313 N87-30036 Flight test evaluation of crew workload. Part 1: Aircraft certification for a minimum crew of two pilots

P 324 N87-30063

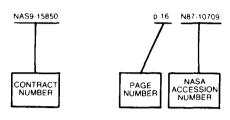
Measurement of aircrew workload during low-level flight.
Part 1: A comparison between in-flight and post flight assessment methods p 325 N87-30064
In-flight assessment of workload using pilot ratings and heart rate p 315 N87-30065
The assessment of workload in helicopters

p 325 N87-30066

January 1988

# AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 305)

# Typical Contract Number Index Listing



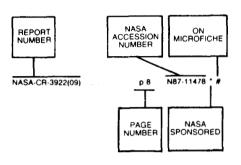
Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

AF PROJ. 7757	p 312	N87-30026
AF-AFOSR-0324-84	p 311	N87-29110
AF-AFOSR-85-0019	p 306	A87-52088
	p 306	A87-52089
BMFT-01-QV-179/13	p 327	A87-53014
DA PROJ. RR0-4108	p 305	N87-30024
DAMD17-85-G-5044	p 314	N87-30046
DE-AC05-84OR-21400	p 325	N87-30070
EPA-R-812156	p 313	N87-30040
F19628-82-C-0081	p 311	N87-29111
F33615-83-D-0601	p 318	N87-30053
F33615-84-D-0658	p 310	N87-29109
F33615-84-K-0610	p 305	N87-30022
F49620-83-C-0026	p 306	A87-52086
NAGW-20	p 303	A87-53830
	p 328	A87-53833
NAGW-297	p 298	A87-52985
NAGW-429	p 316	A87-51165
NAGW-97	p 298	A87-52983
NAG2-100	p 296	A87-51151
NAG2-323	p 297	A87-52979
	p 298	A87-52980
NAG2-362	p 298	A87-52983
NAG2-414	p 311	N87-30025
NAG9-117	p 315	N87-30049
NASW-3676	p 304	N87-29079
NAS1-17919	p 321	A87-53979
NAS1-550	p 321	A87-53979
NAS8-34340	p 320	A87-52992
NAS8-34354	p 320	A87-52992
NAS9-15566	p 302	A87-53619
NAS9-16895	p 321	N87-29117
NAS9-17389	p 320	A87-52992
NAS9-17416	p 302	A87-53615
NATO-84/0667	p 327	A87-53009
NCAZ-05-589-101	p 302	A87-53629
NCA2-OR-675-303	p 302	A87-53624
NCC2-166	p 302	A87-53836
	p 303	N87-29077
NCC2-223	p 315	A87-51164
NCC2-282	p 302	A87-53624
NCC2-287	p 302	A87-53615
NCC2-36	p 327	A87-53005
NGR-05-067-001	p 329	A87-53837
NGR-44-005-002	p 328	A87-53833
	p 328	A87-53834
	p 328	A87-53835
NIH-AM-28602	p 296	A87-52215
NIH-CA-23248	p 302	A87-53619
NIH-EY-00167	p 306	A87-52086
	p 306	A87-52088
NIH-EY-00269	h and	M07-52000

	p 306	A87-52089
NIH-EY-00785	p 306	A87-52086
NIH-EY-01319	p 306	A87-52088
	p 306	A87-52089
NIH-EY-02857	p 307	A87-52093
	p 307	A87-52095
NIH-EY-03196	p 306	A87-52086
NIH-EY-04367	p 306	A87-52088
	p 306	A87-52089
NIH-HL-07027	p 297	A87-52220
NIH-HL-14693	p 297	A87-52222
NIH-HL-19737-10	p 297	A87-52220
NIH-HL-26927	p 297	487-52222
NIH-HL-30556	p 296	A87-52217
NIH-HL-31933	p 296	A87-52215
NIH-HL-33712	p 307	A87-52218
NIH-NS-11632	p 302	A87-53624
NIH-NS-20978	p 302	A87-53624
NIH-R01-EY-01728	p 307	A87-52090
NIH-R01-EY-04776	p 307	A87-52090
NSF CHE-84-01198	p 328	A87-53831
NSF DMB-85-04231	p 298	A87-52983
NSF DPP-83-14180	p 327	A87-53009
	p 327	A87-53010
	p 300	A87-53012
NSF PCM-83-05775	p 298	A87-52985
NSG-7305	p 330	A87-53844
NSG-7337	p 327	A87-53009
	p 327	A87-53010
NSG-7480	p 299	A87-52986
N00014-80-C-0354	p 305	N87-30024
PHS-CA-23248	p 302	A87-53649
	p 302	A87-53650
W-7405-ENG-36	p 303	N87-29078
199-99-00-00-72	p 311	N87-29114

# REPORT

# Typical Report Number Index Listing



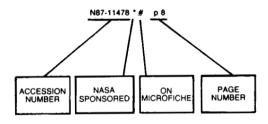
Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (\*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

morenere.			
AAS PAPER 86-114	p 320	A87-53089	
AAS PAPER 86-115	p 308	A87-53090	
AAS PAPER 86-119	p 320	A87-53092	
AAS PAPER 86-120	p 320	A87-53093	
	F		
AD-A157090	p 312	N87-30026	#
AD-A182438	p 310	N87-29109	#
AD-A182699	p 311	N87-29110	#
AD-A182789	p 311	N87-29111	#
AD-A182890	p 305	N87-30022	#
AD-A183109	p 314	N87-30046	#
AD-A183141	p 318	N87-30050	#
	p 305	N87-30030	#
AD-A183204 AD-A183298	p 326	N87-30023	#
AD-A183384	p 318	N87-30071	#
AD-A183431	p 314	N87-30047	#
AD-A183445	p 318	N87-30052	#
AD-A183549	p 318	N87-30053	#
AD-A183562	p 305	N87-30024	#
AD-A183731	p 326	N87-30072	#
AD-A183837	p 315	N87-30048	#
AFGL-TR-86-0139	p 311	N87-29111	#
AFHRL-TP-86-70	p 318	N87-30050	#
AFIT/GE/EE/86D-48	p 305	N87-30023	#
AFOSR-87-0861TR	p 311	N87-29110	#
AGARD-AG-282	,	N87-30054	#
ASAE PAPER 87-0425		A87-52253	•
CESAR-87/08	p 325	N87-30070	#
CONF-870887-1	p 303	N87-29078	#
DE87-010131	p 303	N87-29078	#
DE87-011950	p 325	N87-30070	#
DFVLR-FB-86-61	p 317	N87-29115	#
DRIC-T-7613	p 310	N87-29108	#
EPA/600/1-87/003	p 313	N87-30040	#
ETN-87-90049	p 317	N87-29115	#
ETN-87-90153		N87-29112	#
		20.12	n

JPRS-UBB-87-009	p 314	N87-30042	#
JPRS-USB-87-004	р 309	N87-29080	#
LA-UR-87-1748	p 303	N87-29078	#
LAIR-241	р 318	N87-30052	Ħ
NAMRL-TM-86-1	p 326	N87-30072	#
NAMRL-1330	р 318	N87-30051	#
NAS 1.15:100456	0.311	N87-29114	• #
NAS 1.21:7011(302)			• "
		N87-29117	• 4
			* #
NAS 1.26:181344		N87-29077	* #
NAS 1.26:181349		1401-00020	* #
NAS 1.26:181393		N87-30049	• #
NAS 1.26:3922(15)	p 304	N87-29079	* #
NASA-CASE-LAR-13393-1	p 321	N87-29118	•
NASA-CR-172003	n 321	N87-29117	٠.,
NASA-CR-181344		N87-29077	
NASA-CR-181349		N87-30025	
NASA-CR-181393		N87-30049	
NASA-CR-3922(15)	p 304	N87-29079	* #
NASA-SP-7011(302)		N87-30041	•
NASA-TM-100456	p 311	N87-29114	* #
ORNL/TM-10397	p 325	N87-30070	#
PB87-201356	р 313	N87-30040	#
S-562	р 311	N87-29114	* #
SR-5	p 311	N87-29111	#
SSS-R-86-8064	p 311	N87-29111	#
US-PATENT-APPL-SN-760799	p 321	N87-29118	•
US-PATENT-CLASS-182-223	p 321	N87-29118 1	•
US-PATENT-CLASS-182-63		N87-29118 1	
US-PATENT-CLASS-182-82	p 321	N87-29118 '	
US-PATENT-4,685,535	p 321	N87-29118 1	•
USAFSAM-TP-85-14	p 312	N87-30026	#
USAFSAM-TR-85-31	p 314	N87-30047	#
USAFSAM-TR-85-96	p 310	N87-29109	#
USAFSAM-TR-86-18	p 318	N87-30053	#
USAFSAM-TR-86-44	р 305	N87-30022	#
USARIEM-T-22-87	•	N87-30071	#
UTEC-86-095		N87-30022	#
UTIAS-319	р 317	N87-29116	

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A87-50947	p 315	A87-52987	p 299
A87-50948	p 305	A87-52988	p 299
A87-50949	p 319	A87-52989	p 299
A87-50950	p 306	A87-52990	p 320
A87-51106	p 295	A87-52991	p 299
A87-51107	p 295	A87-52992 °	p 320
A87-51108	p 295	A87-52993	p 299
A87-51109	p 295	A87-52994	p 308
A87-51110	p 295	A87-52995	p 300
A87-51125	p 295	A87-52996	p 300
A87-51151 *	p 296	A87-52997	p 300
A87-51162	p 315	A87-52998	p 308
A87-51163	p 306	A87-52999	p 308
A87-51164 *	p 315	A87-53000	p 326
A87-51165 *	p 316	A87-53001	p 326
A87-51178	p 306	A87-53002 *	p 326
A87-51251	p 296	A87-53003	p 326
A87-51465	p 296	A87-53005 °	p 327
A87-51673	p 296	A87-53007	p 327
A87-51979 #	p 319	A87-53008	p 327
A87-52086	p 306	A87-53009 *	p 327
A87-52087 *	p 306	A87-53010 *	p 327
A87-52088 A87-52089	p 306 p 306	A87-53011 *	p 327
A87-52099 A87-52090	p 307	A87-53012	p 300
A87-52090 A87-52091	p 307	A87-53013	p 300
A87-52091	p 316	A87-53014	p 327
A87-52092 A87-52093	p 307	A87-53015	p 308
A87-52093	p 307	A87-53016	p 308
A87-52095	p 307	A87-53063 #	p 320
A87-52215	p 296	A87-53089	p 320
A87-52216	p 296	A87-53090	p 308
A87-52217	p 296	A87-53092	p 320
A87-52218	p 307	A87-53093	p 320
A87-52219	p 307	A87-53533	p 300
A87-52220	p 297	A87-53534	p 301
A87-52221 *	p 308	A87-53535	p 301
A87-52222	p 297	A87-53536	p 301
A87-52253 *	p 297	A87-53537	p 301
A87-52827	p 319	A87-53538	p 301
A87-52828	p 319	A87-53539	p 301
A87-52829	p 319	A87-53540	p 301
A87-52830	p 319	A87-53551	p 327
A87-52831	p 319	A87-53615 *	p 302
A87-52976	p 297	A87-53619 *	p 302
A87-52977	p 297	A87-53620 A87-53624 *	р 309 р 302
A87-52978	p 297	A87-53624 *	p 302 p 302
A87-52979 *	p 297		
A87-52980 *	p 298	A87-53649 A87-53650	p 302 p 302
A87-52981	p 298	A87-53650 A87-53826	p 302 p 328
A87-52982	p 298	A87-53826 A87-53828	p 328 p 302
A87-52983 *	p 298		p 302 p 303
A87-52984	p 298	A87-53830 ° A87-53831	p 303 p 328
A87-52985 •	p 298	A87-53831 A87-53832	p 328 p 328
		A87-53832 A87-53833 *	p 328
A87-52986 °	p 299	M87-33833	p 320

A87-53834 * A87-53836 * A87-53836 * A87-53837 * A87-53839 A87-53840 A87-53841 A87-53842 A87-53843 * A87-53845 A87-53921 # A87-53921 # A87-54099 * A87-54099	p 328 p 328 p 329 p 329 p 329 p 329 p 329 p 303 p 303 p 330 p 330 p 330 p 330 p 316 p 316
N87-29077 * # N87-29078 # N87-29079 * # N87-29081 # N87-29081 # N87-29081 # N87-29081 # N87-29086 # N87-29086 # N87-29099 # N87-29099 # N87-29099 # N87-29099 # N87-29100 # N87-29101 # N87-29102 * N87-29103 # N87-29104 # N87-29105 N87-29105 N87-29106 # N87-29107 # N87-29108 N87-29107 # N87-29108 N87-29109 # N87-29110	p 312 p 312 p 312 p 312 p 312 p 312 p 312 p 312

N87-30035	#	p 313
N87-30036	#	p 313
N87-30037	#	p 313
N87-30038	#	p 313
NB7-30039	#	p 313
N87-30040	#	p 313
N87-30041 '	•	p 314
N87-30042	#	p 314
N87-30043	#	p 314
N87-30044	#	p 314
N87-30045	#	p 314
N87-30046	#	p 314
N87-30047	#	p 314
N87-30048	#	p 315
N87-30049	• #	p 315
N87-30050	#	p 318
N87-30051	#	p 318
N87-30052	#	p 318
N87-30053	#	p 318
N87-30054	#	p 323
N87-30055	#	p 323
N87-30056	#	p 323
N87-30057	#	p 324
N87-30058	#	p 324
N87-30059	#	p 324
N87-30060	#	p 318
N87-30061	#	p 324
N87-30062	•#	p 324
N87-30063	#	p 324
N87-30064	#	p 325
N87-30065	#	p 315
N87-30066	#	p 325
N87-30067	#	p 325
N87-30068	*#	p 325
N87-30069	#	p 325
N87-30070	#	p 325
N87-30071	#	p 326
N87-30072	#	p 326

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